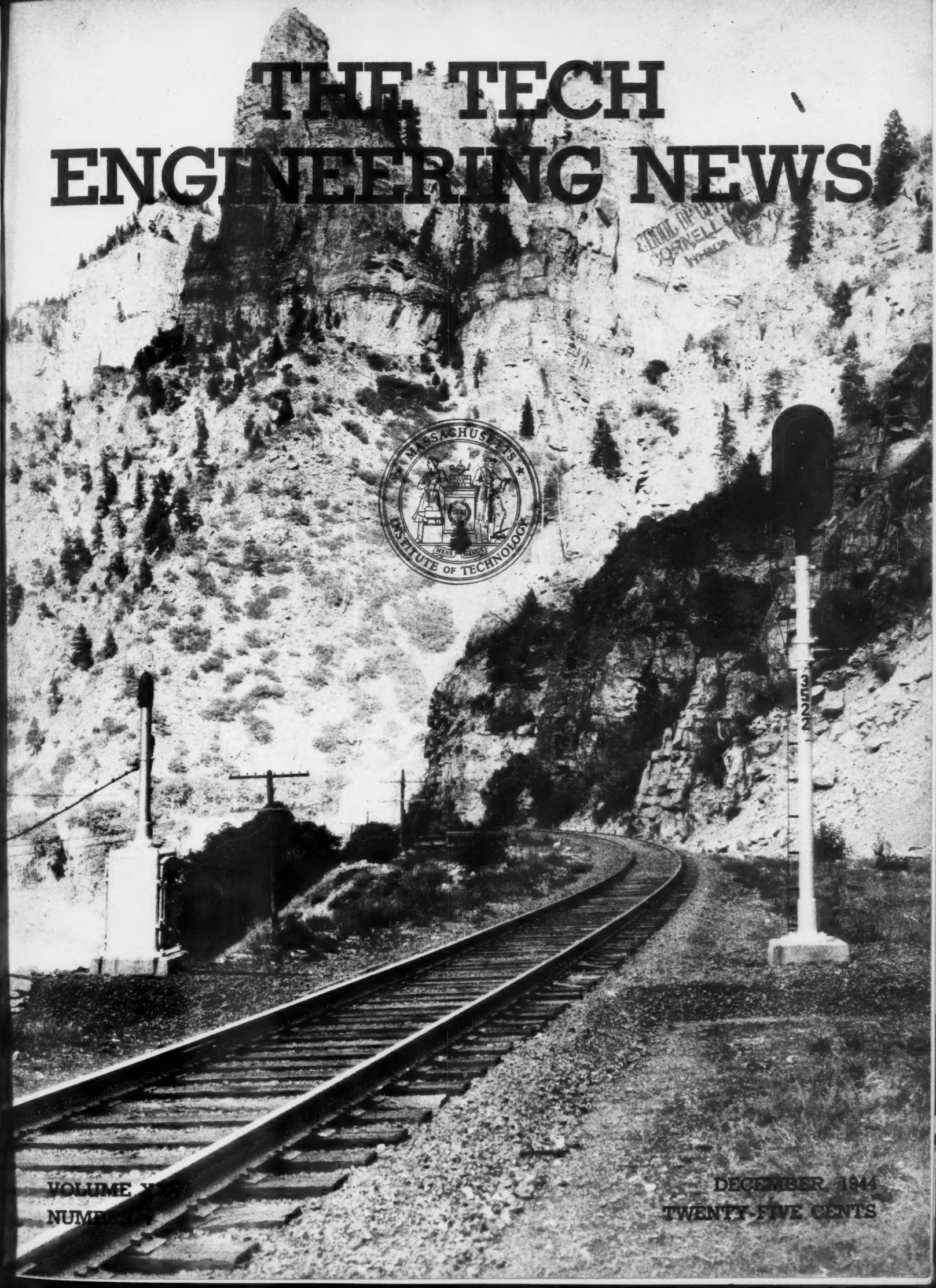
THE TECH ENGINEERING NEWS



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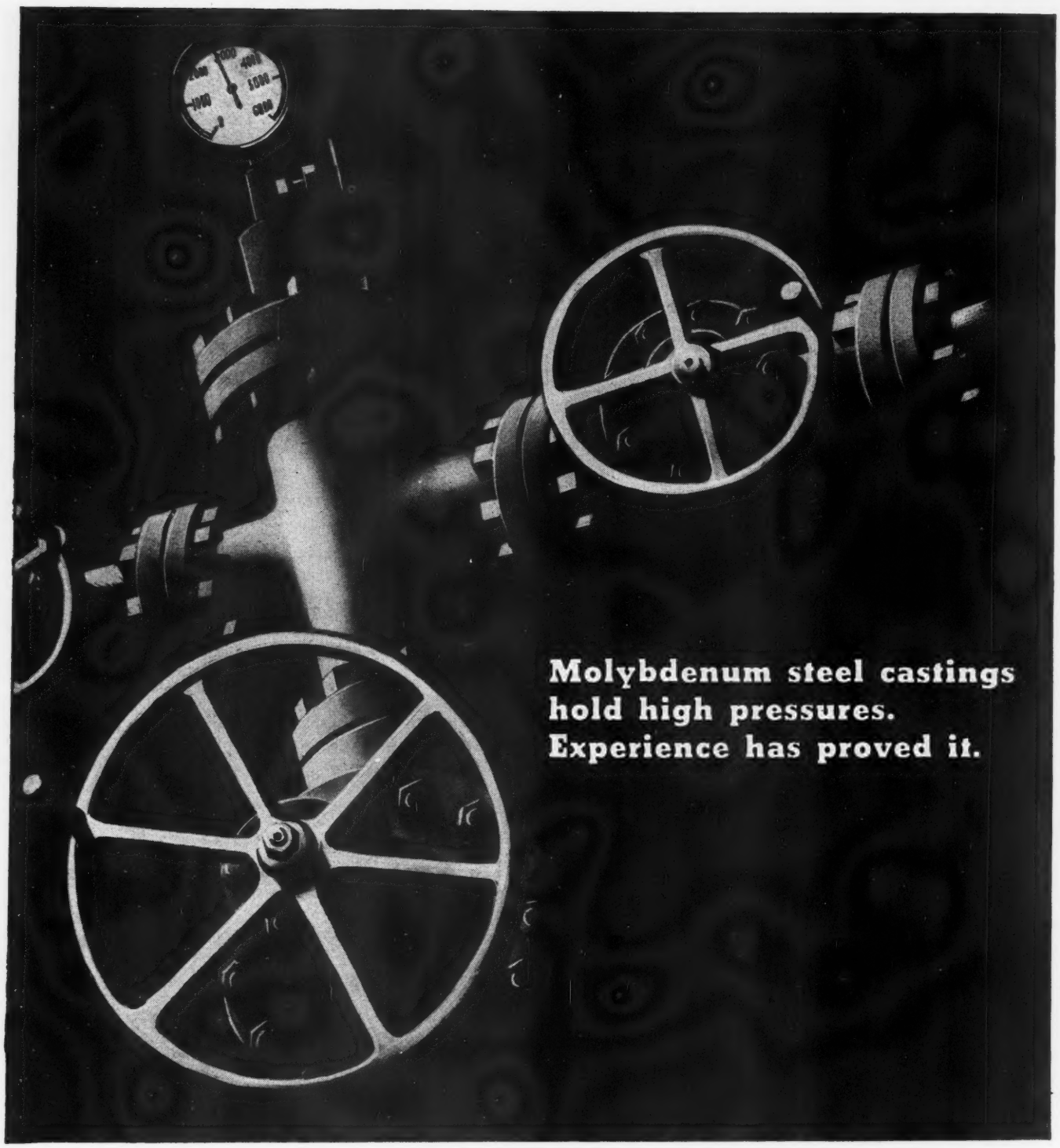

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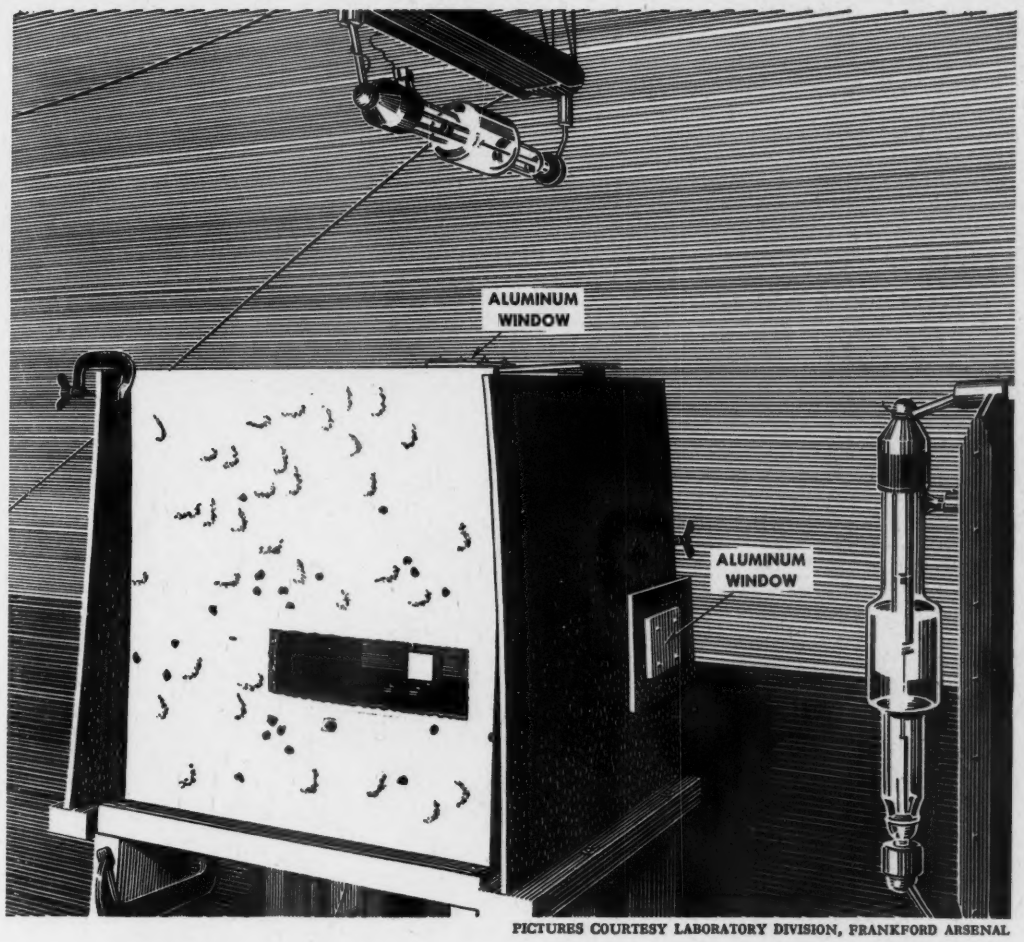

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14,285 times quicker than a wink

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OWI Photo by Palmer, in an Allegheny Ludlum plant

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PEACE

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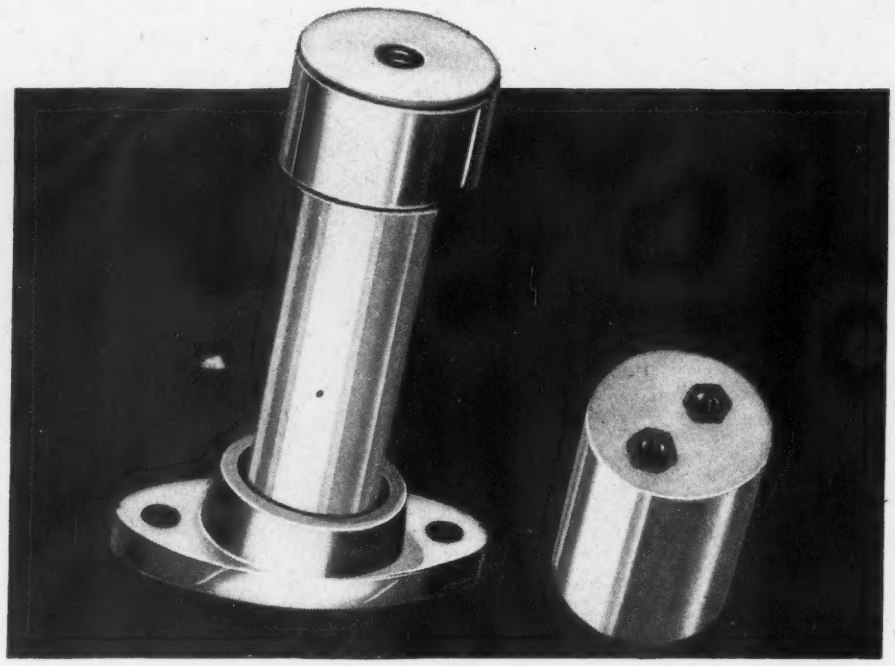
DOW THE DOW CHEMICAL COMPANY, MIDLAND, MICHIGAN



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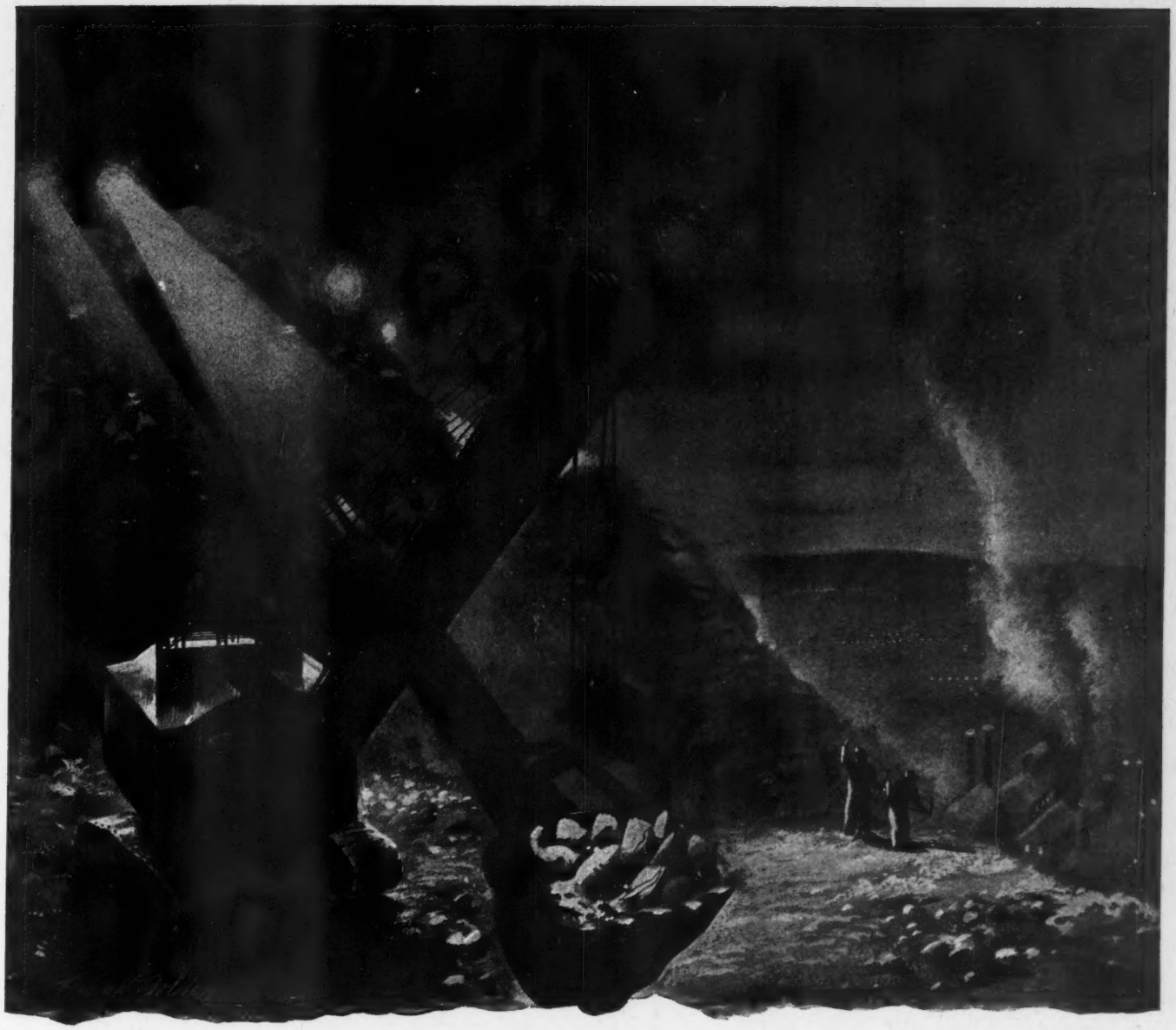

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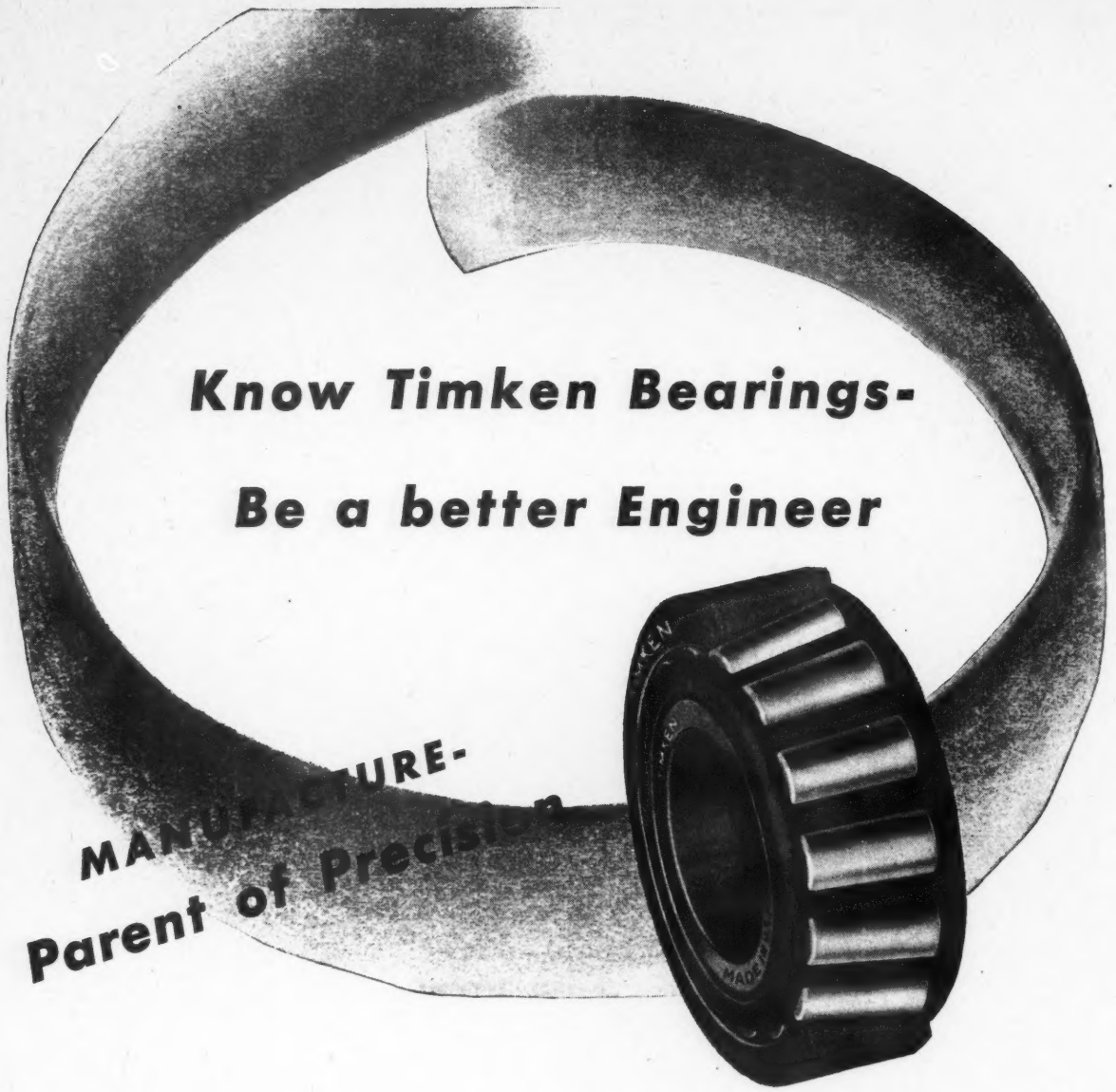

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THE TECH ENGINEERING NEWS

PROFESSIONAL JOURNAL OF THE UNDERGRADUATES

MASSACHUSETTS INSTITUTE OF TECHNOLOGY

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TWO MILLION VOLT X-RAY UNIT FOR INDUSTRIAL USE

General Electric Company

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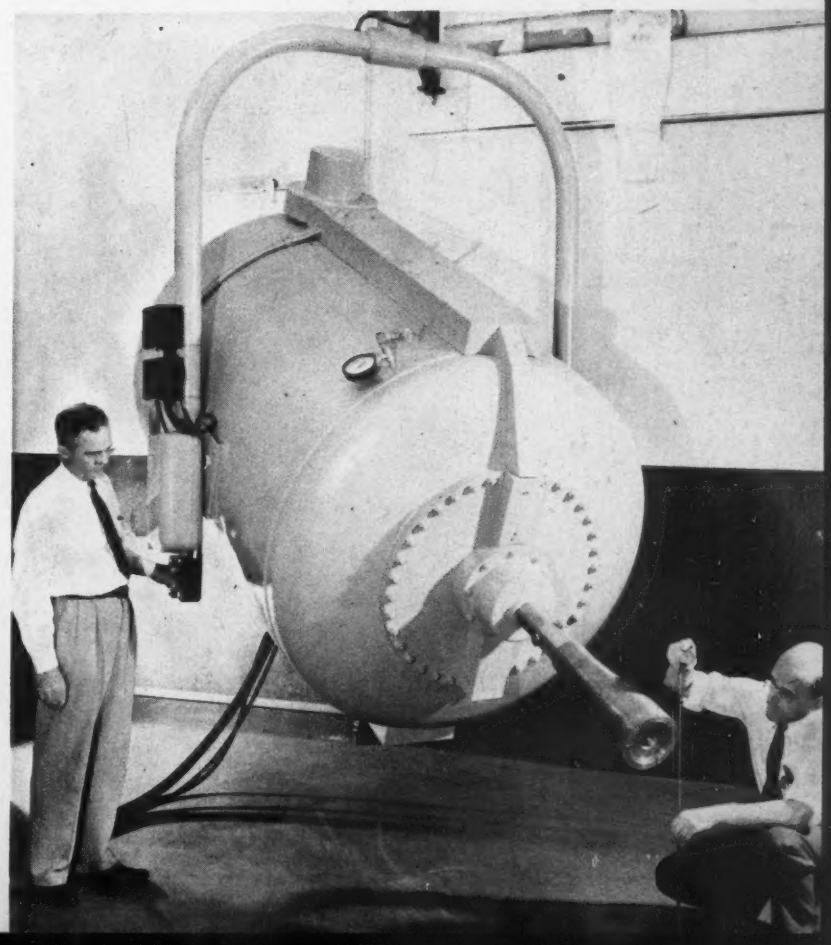
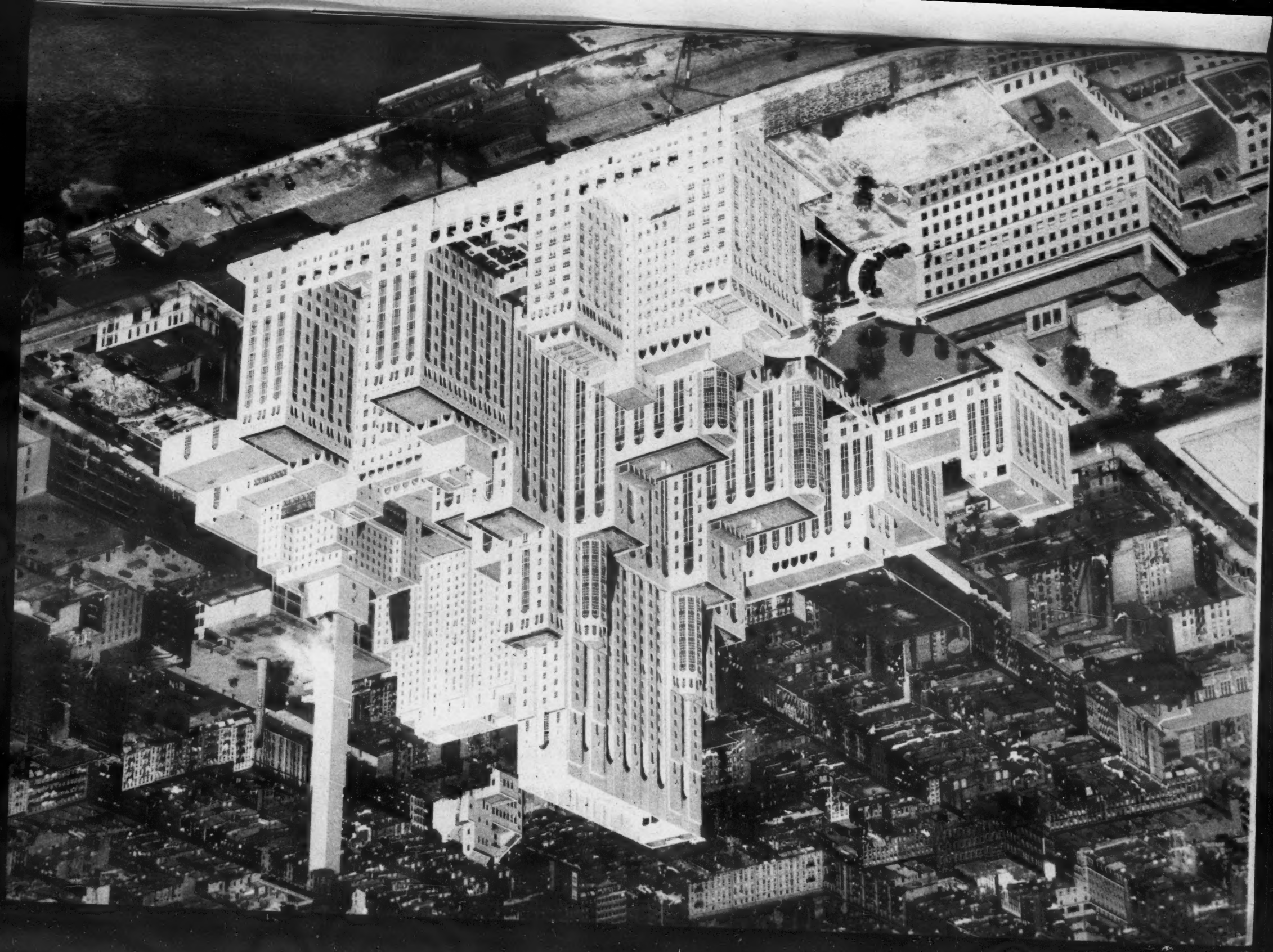




THIS IS M. I. T.

BUILDING ENGINEERING AND CONSTRUCTION

By WALTER C. VOSS

Professor of Building Construction and Head of the Department

FROM the earliest days of man's existence, he has been seriously concerned with the problem of providing food, clothing and shelter for himself. Due to his inability, during many of the early centuries, to avail himself of materials other than those which surrounded him, his diet, his attire and his home were very definite expressions of his immediate environment. During the early periods his home was either a natural cave, a cleft in the rock or one he himself dug from the rock, a unique shelter in the trees of the forest, or a hut whose walls were built of soil and which was roofed with the branches and stalks of trees and wild grasses.

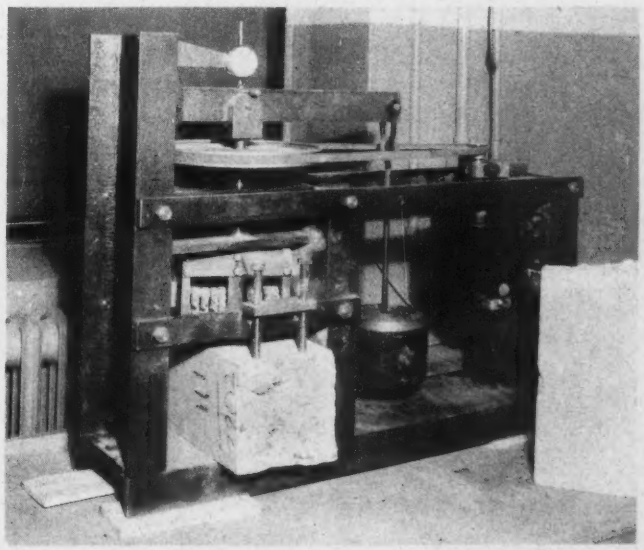
As civilization progressed, the urge to improve his place of habitation resulted in the development of tools to fashion the products of the mountains, plains and forests into more presentable and interesting shapes. As communal life increased, auxiliary buildings became necessary and the initial step was taken in the field of public works. As the small communities associated themselves into small nations, the possibilities for greater accomplishment through the extension of territory became the cause for wars of conquest and exploratory expeditions. These sojourns into foreign lands brought to light many new materials and methods. These were brought home and were woven into the pattern of local building.

This use of relatively local materials and methods went on for many centuries and resulted in the development of local styles of architecture. Each style was an expression of local materials, government and social life. Time and the cost of labor were of no importance. Scarcity of special materials and trained craftsmen were much more important. There was no necessity to integrate labor and materials in order to reduce costs.

As our means of communication and transportation developed, it became possible for man to use methods which were used by builders in foreign countries and to use materials from the far corners of the earth. This development was paralleled by great advances in science and technology. Fundamental techniques in design and construction were of a more or less international type. More recently the development of synthetic materials has increased the scope of knowledge required to design and build successfully. It is in this atmosphere of technology that the construction engineer must operate. He must have the fundamental scientific training given all engineers at the Institute and in addition he must be well trained in the science of materials, in the theory of structural design, in the sequence of job operation and in the all-important phase of coördinating materials and manpower to give maximum production at the lowest possible cost and without the sacrifice of necessary quality. In addition to these the builder must be well grounded in the services connected with all buildings. Thus he must understand the problems of heating, ventilating, air conditioning, lighting, power, and water supply, and be able to coördinate these facilities with the erection of the structure itself. In applying this knowledge to his field, and if he expects to succeed in any of the parts of this highly competitive business, he must understand costs, job management, finance, accounting and the problems of labor management.

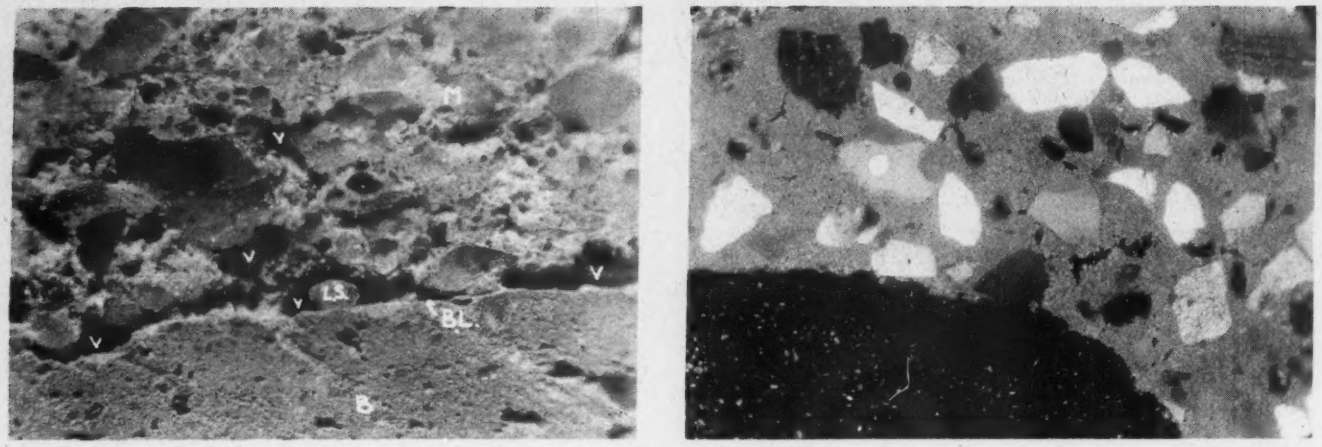
Realizing that such specialized training was not provided by the usual curricula in civil engineering and architecture, Mr. Nathan Horowitz, President of the Thompson-Starrett Company, sponsored the course in Building Engineering and Construction at the Institute in 1927. At present it is the only one of its kind in the country. From the start the course has been based upon two years of study in the basic sciences, the broadening aspects of courses in English and history, and applied mechanics. During the third and fourth years, courses in applied science covering the principles of structures, heat engineering, electrical engineering principles and hydraulics are made a part of the curriculum. In order to apply the theory thus developed to the problem of the building engineer

Machine for conducting wear tests on concrete



$26,000,000 New York Hospital was a challenge to architect, engineer and builder alike

Aerial Explorations, Inc., New York



The microscope reveals the bond between brick and lime mortar in an old structure at left, and between brick and cement mortar in a modern structure at right

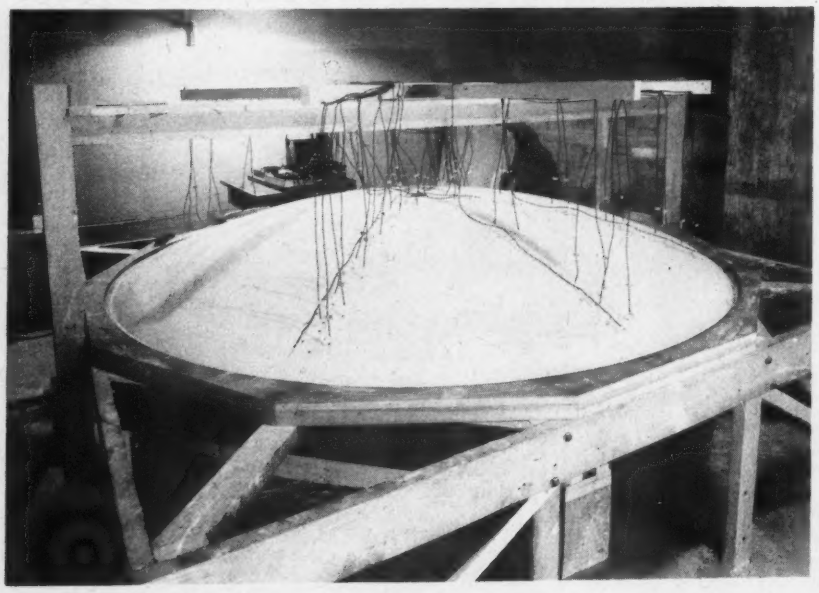
three courses in building construction, three courses in materials of construction, three courses in structural design, and a course in estimating and job management are given.

The building construction courses are given to acquaint the student with the practical sequence of the erection of buildings and the many details and methods now current in the field. The first of these courses considers what is known as third-class buildings generally exemplified by the wooden building; the second of these courses considers what is known as second-class buildings, in which fireproof exterior walls of masonry support a wooden or exposed steel frame so common in apartment houses, schools, churches and like buildings; the third of these courses considers the buildings commonly referred to as first-class or "fireproof" buildings, in which all of the structural elements and enclosing walls are made of fire-resistive materials. The first of the courses in materials is based upon a study of wood and other organic materials, including plastics; the second is a study of masonry materials, including both natural and synthetic products; the third is a study of ferrous and non-ferrous metals. After the student has a knowledge of the techniques of construction and the characteristics of materials he studies structural design in wood, concrete and steel. All of this training is finally applied in the course in estimating and job management, in which the student learns the proper units and methods used in quantity surveys and unit pricing and the correlation of materials and man, power. Job organization, time schedules, expediting, labor relations and contracts are all a part of this problem.

In normal times and during the summer between his third and fourth year the student is provided with placement training in the industry. This plan will be continued after the war and will be expanded to other summer periods when practicable. After this actual experience in the field the student is ready to apply his training and experience to the work of his senior year.

In order to keep the course abreast of the developments in materials, techniques of construction and new principles of structural design the department has established a building materials research laboratory in which new materials or new applications of older materials and methods of construction are studied. The staff are carrying on several such departmental researches and participate in researches under the direction of the Institute's Division of Industrial Coöperation which are arranged with divisions of the industry from time to time. In the field of housing the department has been working on the preparation of panels which may be used in the building of low-cost dwellings. Simultaneously with these practical models a more direct and economical method of distribution and sales is being developed.

Ruge-DeForest gages help in the study of thin shelled domes



The young engineer who enjoys the stimulus of ever changing and complicated problems and who particularly likes the field of management will find in building construction a challenge to his powers of planning and coördination. When Henry J. Kaiser, a builder, built ships, he was exercising his ability as an organizer and coördinator which sprang from his many years in the construction field. His success, so well known to every American, is the story of the application of job-management to a significant project. The young man who wishes to enter such a strenuous, yet interesting field will find much to challenge his ingenuity.

CORROSION OF METALS

A REVIEW OF SOME OF THE CAUSES AND METHODS OF PREVENTION

By Dr. G. G. MARVIN

Professor of Chemistry, Massachusetts Institute of Technology

THE economic importance of corrosion prevention has always been great and has always paid a good reward when intelligently applied. A crude estimate of the cost of corrosion is about five billion dollars a year! Due to the present national emergency, with the existing scarcity of so many metals, the prevention of corrosion in plant equipment rises to a problem of major importance. Therefore, it becomes increasingly important to conserve present plant equipment and material, insuring continuous operation, and at the same time aiding national defense by lessening the needs for industry, not to mention the actual saving in money by such economy. "The elimination of waste is a total asset, there are no liabilities." — Hoover.

Upon looking backward at this time, it seems strange to consider that the prevention of corrosion was not fully recognized as a major engineering problem until about 1920, and it has only been within the last ten to fifteen years that it has been accorded a reasonable part of the research programs in large plants, Government bureaus and technical schools. It now holds a position of commanding importance in all engineering projects, if such projects are to be of lasting value.

In the past fifteen to twenty years, there has been an enormous amount of work devoted to solving the corrosion problem. A large part of this work, by individuals and small laboratories throughout the world, has been careless, misdirected and of little value, due to lack of proper coördination between the workers in this field and the failure to appreciate the large number of factors which must be taken into consideration when dealing with the problem. But like all progress and development, there has emerged from this mass of work a large amount of reliable information which has steadily improved our knowledge of the cause and prevention of corrosion. At the present time, by means of more advanced and more precise scientific methods of control, detection and correlation, a coördinated, related, scientific understanding of the problem is beginning to appear.

The theories on the causes of corrosion range all the way from the carbonic field theory to the colloid theory, to the fantastic or microbe theory, to the electrochemical theory, the last being the only one which is the basis for the modern concept of corrosion of iron. Since iron is the most abundant metal in use today, this theory is very important.

The electrochemical theory states that when metallic iron is placed in water the solution pressure of iron causes it to dissolve until a state of equilibrium is established between the ferrous ions and metallic iron. Solution pressure may be defined as the tendency of a metal to lose electrons and pass into solution as the corresponding ion. Stating this concept in the form of an equation:

$$(1)\ Fe + H_2O = Fe(OH)_2 + 2H\ (atomic)$$

It is evident that unless some factor is introduced to upset this equilibrium, the reaction will cease at this first stage. That it will cease at this first stage can be proven by sealing some clean iron nails in a tube of water from which all oxygen has been removed. There is no evidence of the corrosion of these nails after standing for years. Equilibrium conditions exist within the tube. If the tube is opened and air allowed to enter, or the contents of the tube shaken with air, there is an almost immediate precipitation of ferric hydroxide. This appearance of ferric hydroxide is caused by an oxidation of ferrous hydroxide by oxygen of the air according to the equation:

$$4Fe(OH)_2 + O_2 + 2H_2O = 4Fe(OH)_3$$

Ferric hydroxide being more insoluble than ferrous hydroxide causes a precipitate to form. This appearance of $Fe(OH)_3$ as a precipitate merely proves that some of the iron actually dissolved and was present in the water layer as soluble $Fe(OH)_2$. The theory postulates that the equilibrium in equation (1) is upset by oxygen combining with the hydrogen, according to the following equation:

$$(2a)\ 2H\ (atomic) + 1/2\ O_2 = H_2O$$

which is the equation representing the usual reactions which occur in approximately neutral solutions. The theory also postulates equation 2*b*, which is:

$$(2b)\ 2H\ (atomic) = H_2\ (gas)$$

where the atomic hydrogen which is formed collects to the extent of forming hydrogen gas and escaping as bubbles. Reaction (2*b*) is characteristic of acid solutions on iron.

An examination of the equations will show that oxygen and water are two essential components in order for corrosion to occur. Corrosion of iron at normal temperatures will not take place in the absence of water, and oxygen is essential if corrosion in water at normal temperature is to continue. There are numerous exceptions to any theory and many special cases can be cited to prove and disprove any theory, but the electrochemical theory has stood for a great many years. Likewise it can be applied in a general manner to metals and alloys other than iron.

There are two broad generalizations which can be made at this point. The first is that certain factors will influence the tendency or driving force for a reaction to take place, this being true for corrosion reactions or any chemical reaction. The second generalization is the existence of factors which influence the rate of the reaction made possible by such tendencies.

Primary or initiating factors are electrode potentials, over-voltage, chemical and physical homogeneity, and inherent ability to form a protective film. The secondary, or rate factors, are pH of solution, oxygen in the solution, nature and concentration of ions in the solution, rate of flow, temperature, cyclic stresses, contact between dissimilar metals, and others.

There are about six well-defined forms which corrosion will assume; the recognition of these forms is usually clear and well-defined. The six forms are as follows:

1. Direct chemical. Uniform chemical attack over

(*Continued on page 118*)

JET PROPULSION

By THEODORE R. YOOS, JR., 2-47

OF all the new types of power plants developed to supplement or replace the orthodox internal combustion engine in airborne machines, the most revolutionary of all is the jet propulsion engine. But apparently the jet plane is not destined to play an outstanding role in this war, as its brother the robot bomb has. The Army Air Corps has already cut back production of the Bell Aircraft Corporation's P-59A Airacomet.

The Air Corps, however, is certainly far from dismissing the jet plane with a wave of the hand as can be perceived by the following facts: production of Airacomets will continue at cutback levels, but Bell employment will not be cut; a new $12,500,000 plant will produce jet engines; a new fighter by Lockheed is being tested; and continued research is being carried on by numerous other companies.

Jet propulsion is actually nothing new. Its principles have been known for centuries, and engineers have worked on it for years; there are hundreds of patents covering its divers phases, using both steam and gas as driving forces. Nevertheless, its successful development and application to aircraft has occurred only recently.

Probably the first successful jet-propelled aircraft which was widely publicized was the Italian Caproni-Campini. Its performance, however, was poor compared to that of planes powered by gasoline and even Diesel engines.

In Britain, Group Capt. Frank Whittle had become interested in the possibilities of jet propulsion as a means of power for planes as long ago as 1930, but it was not until 1933 that he began work on his first engine. Four years were spent in preliminary development, but he achieved his aim and the first engine ran successfully in trials during April, 1937. The Air Ministry was naturally aware of the experiments and in 1939 ordered an aircraft to be powered by the Whittle engine. The first successful flight was made in May, 1941.

Two months later full information was disclosed to Gen. H. H. Arnold of the United States Army Air Corps, who, realizing its possibilities, asked at once for a specimen to be sent to the United States. Plans for the engine were flown across the Atlantic, and General Electric was asked to undertake its development here. The engine was flown to Boston from England and taken to the Lynn works of General Electric, extreme secrecy being imposed. Special guards were posted and the English engineers who had flown to this country to aid development were quartered in small hotels in the Boston area, being constantly shifted from place to place. Every person on the project was checked completely.

In fact, Group Captain Whittle visited this country for three months, less than six persons knowing of it at the time.

The Bell Aircraft Corporation was responsible for the development of the first jet-propelled plane in the United States. Soon after the jet engine was brought to this country, Bell began work on the Airacomet.

The P-59A, which weighs more than five tons and has a wingspan of 49 feet, is capable of speeds in excess of 400 miles an hour. It possesses tricycle landing gear and a laminar flow wing, which, when combined with the lack of a propeller, produces extreme efficiency at high speeds.

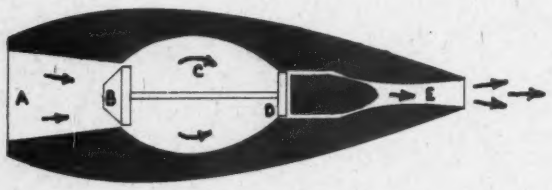
Experimental flight tests of the Airacomet were conducted at a secret base near Muroc, California. Robert M. Stanley, then Bell's chief test pilot, was the first to fly the new jet plane. On October 1, 1942, he took the plane up to a height of 25 feet. On the following day, after several more flights by Stanley, Brig.-Gen. L. C. Craigie became the first army officer to fly the plane.

Considered from a mechanical point of view, the jet engine is little more than a tube containing a minimum of movable parts. Air enters through the intake duct in the front of the engine. It is forced under pressure into the combustion chamber by rotary high-speed compressors. It is mixed with kerosene, the combustion causing a constant high pressure which forces the gases through a turbine. The turbine in turn drives the compressors, while the gases are forced back through the narrowed jet which increases their velocity, giving the plane its thrust. An external source of electrical power is generally used to start the engine. So little vibration is produced that a vibrator is installed in the instrument panel to eliminate "stickiness" from the instrument needles.

The advantages offered by successful jet propulsion are so great that it may indeed soon outmode the present conventional types of power. These advantages include aerodynamic efficiency of the airplane; smaller and lighter landing gear (the present extended mechanisms are necessary only because of the large diameter propellers); a more servicable plane, since it can be built lower to the ground, and a power plant that should be relatively simple to manufacture.

There are still many disadvantages to overcome. To get the most out of your jet plane it must be moving at somewhere near the speed of sound, but at this point a new problem turns up to harass the aeronautical scientist seeking higher speeds. This problem is compressibility — the air piles up in front of the wing, breaking up the smoothness of airflow over the wing surface. The wing is then buffeted by shock waves which impair its lifting ability. Until this

Schematic diagram of jet unit
A — Intake *C — Combustion chamber*
B — Compressor *D — Turbine* *E — Nozzle*



This view of the propellerless plane, which is built low to the ground, shows how snugly the thermal jet engines hug the fuselage. Also clearly outlined are the tricycle landing gear, the wide, sweeping wing and some of the armament in the nose.

Bell Aircraft Corporation

problem is solved, the airplane cannot go fast enough to make full use of its jet power plant.

Another problem that must be solved lies in the province of the metallurgist. Most engines of the jet type are now run below their most efficient operating temperature to increase their life. When new alloys come along which are able to withstand higher temperatures, jet engines will be much more efficient machines.

Despite all its disadvantages, the jet engine is efficient. With the improvements which are certain to come out of modern technology the jet type engine can look forward to a promising future.

This is the shape of things at present. The shape of things to come is unpredictable, but it seems certain that jet propulsion has a future, not only in aviation, but in fields where it has heretofore not even been considered.

The Army Air Forces' P-59A Airacomet, the jet-propelled fighter plane designed and built by Bell Aircraft Corporation of Buffalo, N. Y. This three-quarter rear view of the propellerless plane gives a clear outline of its long, upswept tail and the tail nozzles of the thermal jet engines, hugging the fuselage on the inboard edge of the wide wing. The P-59A gets its high speed from the powerful thrust of the gases leaving the nozzles of the jet engines.

Bell Aircraft Corporation

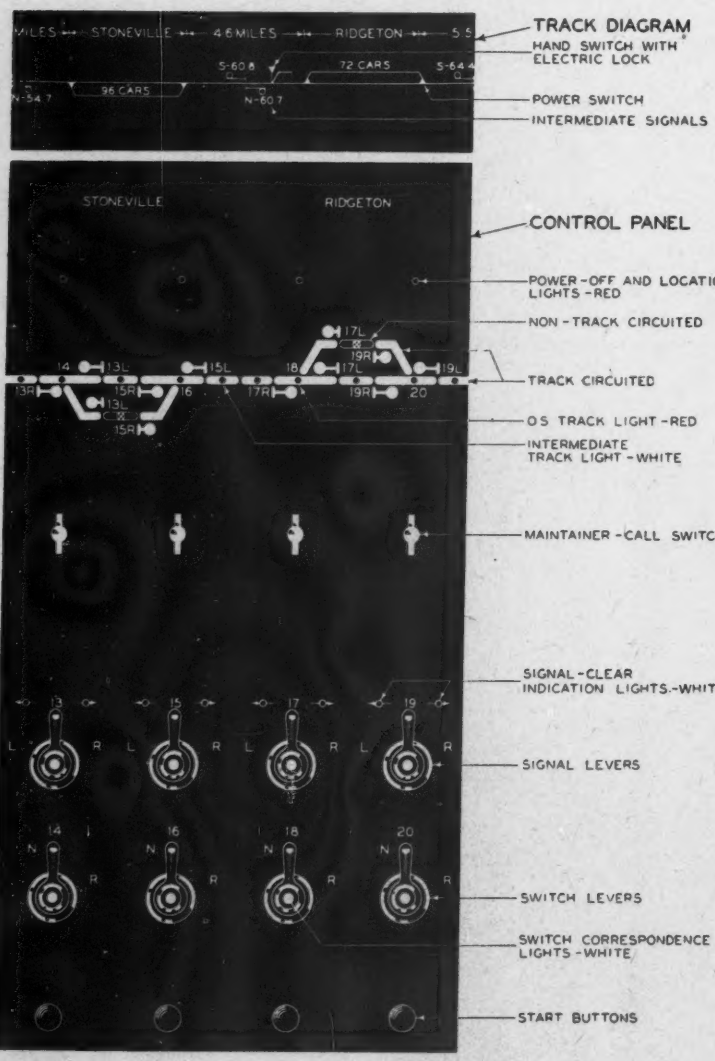
RAILROAD JUNCTION SIGNALING

By RICHARD W. SPENCER, 2–47

(Illustrations courtesy General Railway Signal Company)

JUNCTION signaling differs from block signaling in that it cannot be completely automatic. Obviously, where trains may take different routes, there must be someone to set up the proper route for each train.

Among the several ways of handling the problem are the mechanical, electric, electropneumatic, and various combinations of these.



Typical control panel with supplemental track diagram

In the mechanical system, the switches and signals are controlled from a signal tower near the junction by means of a system of rods and levers, so interlocked that the towerman cannot clear any signal unless all switches in the junction are properly set. This system is in wide use, but it has numerous disadvantages, among which are difficulty in lubrication, freezing in cold weather, and lack of block indications; that is, a signal, since it is interlocked only with switches, derails, and other signals, can be cleared when there is a train just beyond it. Some railroads have solved this problem by installing electric signals with their mechanically operated switches, and some have gone so far as to completely electrify their junction systems, including the switches.

None of these systems were totally satisfactory for the control of traffic at long distances from the tower, either because of friction in the controlling rods or because of the large number of wires necessary.

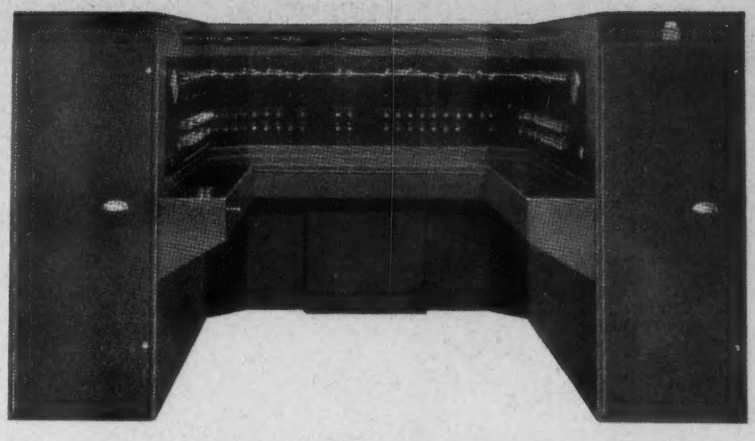
The solution to these problems appeared in the form of a new method of electric signaling called Centralized Traffic Control. CTC is well adapted for the control of traffic at long distances from the tower; a good example is the one hundred and five miles of track between Akron and Derby, Colorado, on the Burlington, which is operated from one signal tower.*

The CTC control machine is contained in a steel cabinet, on the front of which are switch and signal control levers, track model, code starting buttons, and other apparatus. The track model is merely a map of the track controlled by the tower, and is divided into sections, each of which is illuminated by a small light when that section is occupied. Below the track model are the switch and signal levers arranged in two horizontal rows. Below these levers is a row of code starting buttons, the function of which will be explained later.

The switch levers are small double-throw electric switches. A switch lever is set in its normal position to throw the track switch to its normal,

*Manufactured and installed by the Union Switch and Signal Company.

or straight position, and is set in its reverse position to throw the track switch to its reverse position. The signal levers are similar to the switch levers, except that they are three-position switches. To clear a signal for traffic to the left on the track model, the signal lever is set in its left position. To clear a signal for traffic to the right, the lever is set to its right position. Setting the signal lever in the center position sets the signals controlled by that lever to the danger, or red indication. Each switch lever and signal lever is equipped with indication lights which show in what position the switches or signal on the track is set. No controls are sent out, however, until a code starting button is pressed.



Control machine providing supervisory controls and indications for operation by centralized traffic control of 111.0 miles of single track line. Note the supplementary track diagram across the top of the machine and the built-in automatic train recorder located in the center desk shelf. The Type K, Class M, Size 10, CTC System was employed on this installation. The CTC line is equipped for through telephone circuit.

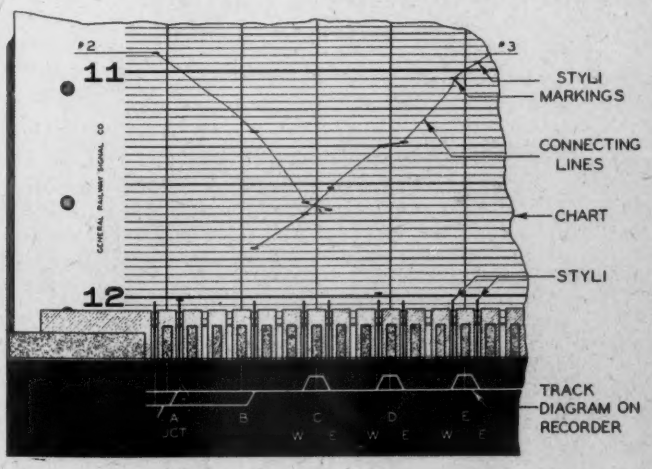
As has been said, CTC is well adapted for use over long distances, whereas other types of electric signaling are not. This is because only two or three wires are used to connect the control apparatus to the field apparatus.

Each coding button with the signal lever, switch lever, and section of track model directly above it constitute a station on the machine. When a coding button is pressed, a series of electric impulses is sent out on the control line. In any particular machine the number of impulses is constant, and the code is determined by the character of the impulses, which may be long and short, or positive and negative. The first part of the code determines which stations act, and the last part determines the position of the switches and signals. This code, which is set up by relays in the control machine, is received by relays at the field location, which cause the proper action to take place. Indications are sent back to the tower by relays at the field location and are decoded by relays which cause the proper indications to show on the control board.

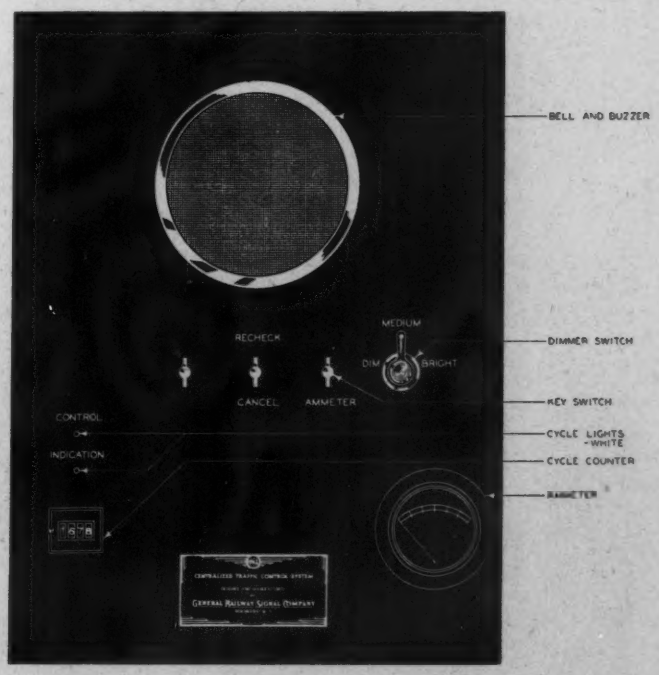
In the event that two coding buttons are pressed simultaneously, or two stations try to send indications at the same time, one code is temporarily stored while the other is sent. If several codes are initiated at the same time, they are sent in a predetermined order, one at a time, since the receiving relays are not able to decode more than one code at a time.

Through the use of CTC, one train director may personally control the movements of all trains in his territory, thus obviating the necessity for written train orders. With CTC, within a few seconds of when the towerman presses a code starting button, a switch fifty miles away changes position, and full indication of conditions at the field location is relayed to the tower. Used on single track line, CTC makes possible the passing of trains on sidings without stopping. Although the installation may cost several hundred thousand dollars, it usually pays for itself in a few years. CTC controls junctions more safely, efficiently, and with less expense than any other type of junction control.

Portion of automatic train recorder chart with styli markings and with connecting lines partially drawn in. The recorder is all-electric in operation, the styli markings being made by the passage of electric current from styli through the chart.



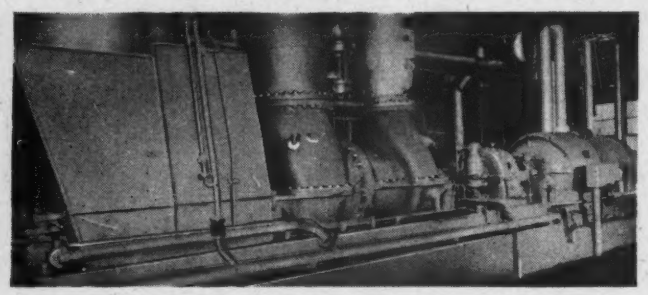
Typical master panel



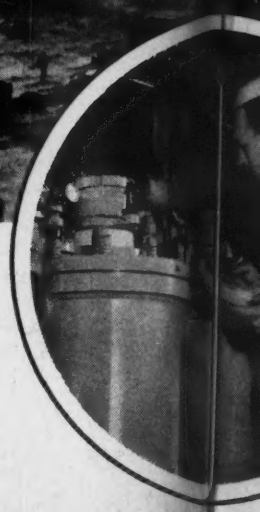
"MADE IN AMERICA" IN THREE

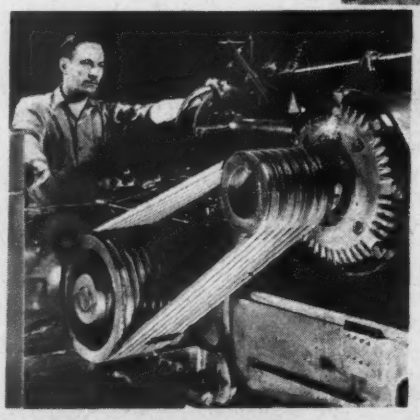
Man's Mightiest W

How Allis-Chalmers engineering and equipment helped U. S. Industry solve the biggest production problem of all time... 3 important A-C developments that greatly speeded the job!



1. **A-C GAS TURBINES** in U. S. oil refineries helped mass produce super aviation fuel for Uncle Sam's fighting planes. Called "first really new kind of power plant in 50 years," gas turbines are already predicted for locomotives, ships, many other post-war machines.





2. **MULTIPLE V-BELTS,** invented by Allis-Chalmers, drive 75% of all U. S. machines turning out weapons of war. Since 1941, thousands of guns, tanks and planes have been produced with their help—*with tremendous power savings!*

3. **A-C MERCURY ARC RECTIFIERS** were important factors in breaking the aluminum bottleneck after Pearl Harbor. They provided a cheap, fast way to convert alternating to direct current for mass production of aluminum and magnesium for war planes. Helped build the air armadas that blast the way for U. S. invasion troops!

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Back of our rapid military growth, stands U.S.A.'s unique ability to produce almost anything faster than any other nation. To this ability, Allis-Chalmers has made many important contributions that help speed war output in almost every branch of industry. In post-war plans, call on this vast industrial experience to help solve production problems—effect vital peacetime economies!

VICTORY NEWS

New "Streambarker" for Paper and Pulp Mills. First hydraulic barker ever designed for standardized production, Allis-Chalmers' new Streambarker not only eliminates hand cleaning of pulpwood logs but saves man-hours and money for mill operators by completely eliminating pulp loss from "broomed" log end.

Secret is water under 650 pounds pressure which removes bark as logs are revolved and propelled through the Streambarker. It handles logs 4 to 8 feet long, 4 to 10 inches in diameter. Write for Bulletin B-6341.

Hunting Defects is His Business! The man above is giving A-C motor shafts the "eagle eye." It's true he doesn't find many defects. But none that are there get by him!

Careful inspection of all parts is one more reason why you can depend on Allis-Chalmers motors for long-life performance!

New 80,000 kw Giant Bids for Record! So satisfactory was the first Allis-Chalmers 80,000 kw steam turbine generator installed at Port Washington, Wis., that the power plant became known as the "World's Most Efficient."

Today, Port Washington has a "sister" A-C turbine of same kw which promises to exceed even the original in performance due to modifications in design which increase capacity and reheat temperatures. By shipping sub-assemblies direct to the sites for field erection, commercial operation of this turbine was possible 60 to 90 days ahead of normal.

Allis-Chalmers Mfg. Co., Milwaukee, Wis.

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WHAT ABOUT CARTELS?

On November 18, 1944, the International Business Conference gave its approval to the use of cartels in postwar world trade. This action was based upon a report presented to the Conference which stated that it was essential to preserve the benefits derived from cartels, while their use in any manner contrary to public interest was to be shunned. It is interesting to note that the report was adopted by the Conference without a dissenting vote, despite the alleged stand of the United States Government opposing cartels, and despite the content of the report of the Senate's Kilgore Committee on Cartels and National Security, which was made public five days earlier.

The report presented to the International Business Conference defined cartels in part as "agreements . . . between independent private parties . . . which provide for regulation of production, orderly marketing, coördination of prices, and the exchange of technical knowledge and experience and patents where they are connected with production or marketing schemes." The Kilgore report showed that wherever such an agreement existed it tended to produce operation in restraint of trade. The formation of trade monopolies and the inevitable result of economic restriction is an inherent fault of the cartel system. Since the system is essentially one of individual agreements between independent private parties, it is easy to see that exchange of technical knowledge and patents may also be suppressed when such exchange is not to the advantage of the controlling interests of the cartels involved. This deliberate impedance of technological progress which enables a small group to profit at public expense is a more or less common practice of the cartels, according to the Kilgore report. Such a state of affairs is exactly opposed to the resolution contained in the report adopted by the Business Conference, since it is clearly opposed to public interest.

A comparison of the advantages and disadvantages of the cartel system, based on the information made public in the Kilgore report, shows that the disadvantages far outweigh the advantages. The only advantages apparent in the system are that it helps to stabilize exchange rates and that it stimulates expansion of certain industries. We hasten to add, however, that expansion is not always desirable, and, moreover, that cartel-induced expansion occurs only to the extent to which the controlling interests of the cartel will profit, regardless of public interest. The disadvantages of the system are most concisely expressed in the Kilgore report, which we quote:

"The extensive testimony before this committee . . . established beyond question that the international cartel system has been subversive of political security, full production and employment, and the expansion of world trade. These effects have not been incidental to the operation of the cartel system but have arisen out of its essential character.

"Private restrictive economic agreements designed to maximize profits inevitably minimize political security, jobs, and world trade."

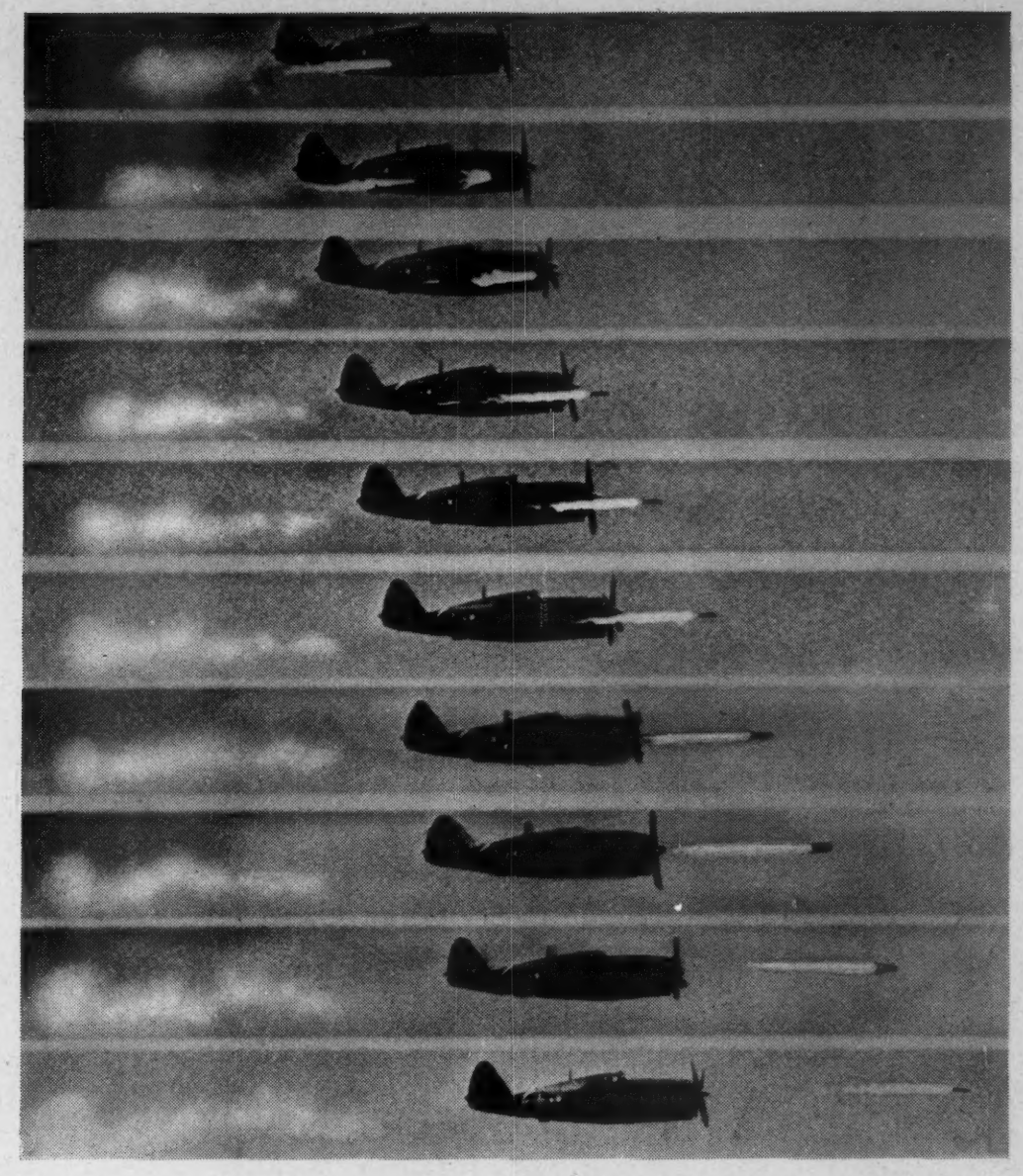
It seems obvious that such a system of international trade with its attendant undermining of diplomatic relations, could only lead to war, as indeed it did. Unless the cartels as they existed immediately before the war are destroyed, the foundation for a third world war will have been laid, despite all efforts to the contrary.

Finally, it has been argued that an international registration of cartels, subject to governmental scrutiny and under the control of the United Nations, will give the cartel system the character of international coöperation, and will eliminate its monopolistic and restrictive tendencies. However, the proposals for maintenance of the cartel system, despite verbal support of international coöperation, still embody the perpetuation of the old controls and relationships which have made the cartel system so dangerous to world unity. To quote the Kilgore report once again:

"A cartel system dominated by American or British interests would eventually produce the same undesirable results as the one exploited by the Germans. It would jeopardize peace and jobs in the postwar world and soon bring us face to face with the possibility of a third even more destructive world war."

The resolution in the report adopted by the International Business Conference states nothing that is not implicit in the many plans advanced for postwar reconstruction. We fail to see, however, how the object of this resolution can possibly be attained through the use of a system of international trade which has been tried and clearly shown to be defective. It is doubtful whether any modification of the system, through government control or otherwise, can so improve it that its use will not eventually precipitate another war.

The cartels must go. R. B. M.



NEW CAMERA "SHOOTS" FLYING PROJECTILES

WHEN Army ballistics experts needed to photograph speeding rockets, scientists at Bell Telephone Laboratories built the special "ribbon-frame" camera.

Their experience came from making high speed cameras to study tiny movements in telephone equipment parts.

The new camera gets its name from the narrow slot that exposes a ribbon of film at a speed of one ten-thousandth of a second. These "stills," taken on ordinary film, show a fast flying P-47 firing its under-wing rocket.

This is an example of the many ways Bell System research is helping to provide better weapons, better equipment for war and peacetime telephone service.

BELL TELEPHONE SYSTEM

Service to the Nation in Peace and War

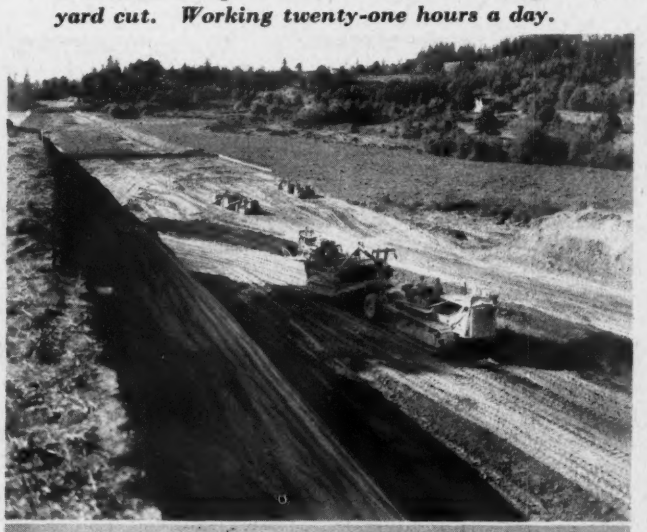
TRACTORS AT WORK

(Photos courtesy Caterpillar Tractor Company)

"Caterpillar" Diesel D2 tractor pulling 3-16 inch and Diesel D4 tractor pulling 5-16 inch plows, plowing wheat summerfallow in wet bottom land. Working ten hours a day, the D2 uses one and one-half gallons of fuel per hour and the D4 two gallons.

Relocation U. S. Highway 99 near Woodland, Wash. A fleet of "Caterpillar" Diesel D8 tractors with Le Tourneau scrapers and bulldozer making 150,000 yard cut. Working twenty-one hours a day.

"Caterpillar" Diesel No. 112 motor grader building ditches along highway leading into Army General Hospital, Charleston, S. C. Working eight hours a day on 1.2 gallons fuel per hour.



Camp Cooke, Lompoc, Calif., will cover 97,000 acres and house three Army divisions. "Caterpillar" Diesel D7 tractor with LeTourneau bulldozer building seven miles of highway into the camp.

Two "Caterpillar" Diesel D2 tractors with Oliver 4-28 inch disk plow and another D2 with 10 feet drag preparing land for corn. Covering about one and one-quarter to one and one-half acres per hour, working ten hours a day, each tractor uses less than two gallons of seven cent fuel per hour.

"Caterpillar" Diesel tractors with pipe layers handling 24 inch pipe for War Emergency Pipelines, Inc., in Pennsylvania, working eight to sixteen hours a day.

"Caterpillar" Diesel D2 tractor pulling Oliver 4-14 inch plows, plowing summerfallow. Working second gear, covering approximately one and one-half acres per hour. Working twelve hours a day on one and one-half gallons seven and one-half cent fuel per hour. Farms 240 acres and does considerable custom work.

"Caterpillar" Diesel D6 tractor with LaPlant-Choate trail-builder grading new streets in new housing project in Washington, D. C. Working eight hours a day, the D6 uses about four gallons fuel per hour.

THE BULLETIN BOARD

HONORARY AND PROFESSIONAL SOCIETIES AT M. I. T.

TAU BETA PI

At the general meeting of the Technology Chapter of Tau Beta Pi on Monday, November 20, 1944, plans were made for the election of new members this term. A Smoker to take place on Monday, November 27, 1944, for those eligible for membership was decided upon. The qualifications for membership are scholarship — the prospective member must be in the upper fifth of his class if a senior and in the upper eighth of his class if a junior — service, breadth of interest, and integrity. Eligible prospective members were to be notified by the fraternity during the week preceding the smoker.

Plans were also made at this pre-election meeting for an active program of service about M. I. T. A tentative calendar of events and plans for future activities was discussed. The possibilities of acquiring documentary films for showing at Technology was also a subject of discussion. William F. Blitzer, 6–45, president of the chapter, presided at the meeting.

AMERICAN INSTITUTE OF CHEMICAL ENGINEERS

The M. I. T. Student Branch opened the term's activities by presenting Prof. H. P. Meissner of the Chemical Engineering Department of M. I. T., who spoke at the first meeting of the term on the Aims and Purposes of the A. I. Ch. E. The talk presented on Friday, November 24, was intended to introduce the society to those who were interested in its activities but not already familiar with it. The A. I. Ch. E., in presenting this introduction to its activities, hopes to interest prospective members in participating in the society and enlarging its range of activity.

Future plans of the A. I. Ch. E. include a plant trip to the General Ice Cream Corporation, to take place on November 30, a talk by Dr. W. K. Lewis, head of the Chemical Engineering Department at M. I. T., on the subject of fluidized coal, to be given on December 12, and a subsequent group trip through the Powdered Coal Plant in Building 38 at Technology on December 14.

Further plans include a talk in January by Professor Williams on beryllium, and a trip during that month to a brewery. Through these activities it is hoped that the experience and interest of the members in the various phases of chemical engineering will be extended and broadened.

MATHEMATICS SOCIETY

The M.I.T. mathematics society opened its activities for the fall term with the election of new officers. Ross E. Graves, 6–45, was elected President; Louis B. Wadel, 2–46, Vice-President; and Ralph G. Selfridge, 2–47, Secretary-Treasurer. A policy calling for weekly meetings with talks alternating in difficulty was adopted. The members were called upon to volunteer to speak and to furnish suggestions for topics. The first two speakers of the term were O. G. Selfridge, 6–45, and F. E. Browder, 2–47. The mathematics societies of the colleges in the vicinity have been contacted, and it is hoped that profitable relations for both Technology and the other groups will develop. The members of the society have been invited to attend the meetings of the Harvard society. It has been emphasized that one main purpose of the M. I. T. mathematics society is to make mathematics an educational entertainment, and lift it from the realm of boresome chores.

PHYSICS SOCIETY

At the beginning of this term a constitution was approved by the members of the physics society, and the following officers were elected to serve during this term: President, F. H. Low, 2–46; Vice-President, W. I. Lang, 10–44; Secretary, J. M. Dudley, 2–46; Treasurer, D. Mintzer, 6–45.

The physics society's first lecture of the term was delivered by Professor Slater, head of the Physics Department. Speaking November 20 on the future of physics, Professor Slater stressed especially the value of reviewing the development of physics during the past two decades in constructing a clear picture of the future. He predicted a significant advance in the theoretical development of nuclear physics as a predominant part of postwar science, but stressed the growing importance of practical applications and devices to progress in physics.

The next activity was a conducted tour of the cyclotron, arranged for members only. Membership in the society has reached forty-five.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS

The Student Branch of the A. I. E. E. under the directions of its newly elected officers has recently completed arrangements for several outside speakers to appear at the Institute.

(*Continued on page 122*)

America's NEW Frontier

● IN AMERICA'S EARLY DAYS of growth, opportunities for progress lay in the ever widening frontiers. In the fertile lands of the great plains . . . in the timber of our forests . . . in the metal of our mines.

Today, we have reached the limit of our physical frontiers. But new frontiers lie before us—new opportunities for exploration—in our research laboratories. Here in the multiple world of the electron tube are being born the scientific advances that will make our world immeasurably safer and happier.

Pioneering on this new frontier of research are RCA Laboratories in Princeton, New Jersey. Today RCA Laboratories are devoted to providing the fighting forces of the United Nations with the best radio and electronic equipment available. Tomorrow, this same skill will continue to serve America in creating new and finer peacetime products.

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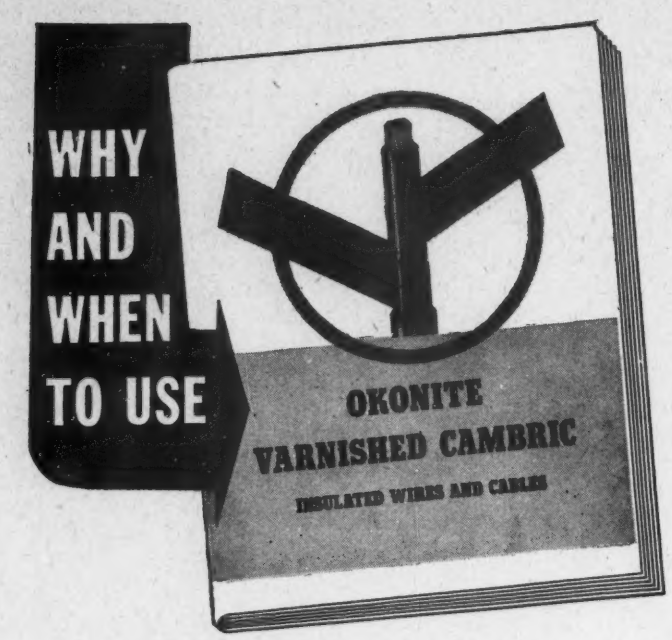


BULLETIN OK-1013 tells where and how to install Okonite Varnished Cambric Insulated Wires and Cables. Secure it by writing to The Okonite Company, Passaic, New Jersey.

OKONITE
INSULATED WIRES AND CABLES 3724

CORROSION OF METALS

(Continued from page 117)

the entire surface. The metal surface is smooth, but etched, as in steel from pickling solutions.

2. Pitting. Characterized by localization of attack within well-defined areas which have penetrated well below the surface. This form is the worst offender and most common type as far as loss of equipment is concerned.

3. Two-metal galvanic action. May be pitting or general type of corrosion easily recognized by direct connection of one metal to another metal under corrosive conditions. Very destructive if the two metals are widely separated in the electromotive series.

4. Concentration or solution cell. Again a pitting type of corrosion identified with a condition which will develop due to cell action. Such cells may be (*a*) two different metals in the same electrolyte, (*b*) two metals in different electrolytes, (*c*) same metal in two different electrolytes, (*d*) same metal in two concentrations of same electrolyte, (*e*) oxygen concentration cells where the same metal is in the same electrolyte, but two different concentrations of oxygen exist, as well as many others. A recent article by Mears and Brown lists and describes seventeen cases for initiating corrosion currents.

5. Dezincification. A very characteristic, well-defined type of corrosion as applied to brasses. The term is self-explanatory in that there is an almost complete loss of zinc and the metal takes on a deep, spongy red appearance of copper. This form is very destructive when present.

6. Corrosion Cracking. A form of corrosion where the corrosion has occurred around the grain boundaries and the metal often flies apart due to existing stresses. This form is largely restricted to brasses.

This brief review of the theory, factors and types of corrosion may be very sketchy and inadequate but seems desirable before any reasonable attack upon preventive measures may be undertaken.

At this point, an outline of preventive measures, which may be employed to lessen or prevent corrosion, will give in a condensed form more information than any other arrangement.

Preventive Measures Available

I. By controlling composition of metal; examples: stainless steel; nickel alloys of monel, inconel, nickel silver, and nickel; brasses, bronzes; high silicon iron, aluminum alloys, and many other compositions.

II. Protective Coatings:
   - (*a*) Metal coatings by rolling, dipping, spraying, electroplating, metallizing, sherardizing, and others.
   - (*b*) Non-metallic coatings other than paints: aluminizing, oxide coatings, glass or ceramic coated, concrete, rubber, and others.
   - (*c*) Paints — oil paints, lacquers, bituminous coatings, asbestos and bituminous material, and others.

III. Passivation: In water solutions by means of inhibitors such as chromate, silicates, phosphates, and others. Stabilized passive state as in stainless steel.

Under the heading of metal composition, a few typical examples of stainless alloys of the ferrous and non-ferrous class are given. There are actually numerous alloys of each type that are available and each one usually possesses certain advantages and disadvantages, depending upon the uses to which it is to be subjected. It is possible here to deal with only two or three of the most commonly used alloys which have proved to be of value from the corrosion resisting point of view.

Stainless steel may be defined as a stabilized passive alloy, where passivity is defined as a shift in the position of a metal in the electromotive series from an active position toward that of the noble metals. The ability to shift ordinary iron from its usual position to that of a noble metal has been known and practiced for over a hundred years. But no method was known for holding the iron in this passive or noble state, and the slightest disturbance caused it to shift back into a normal state of an active metal. It remained for Brearley to produce a stabilized chromium alloy of the stainless steel type and popularize it as stainless cutlery. Other workers of this period were Hayes, Beckett, Armstrong, Johnson, Maurer and Strauss. From the work of these various pioneers the 18-8 type (18 chromium, 8 nickel) of today has emerged, and Strauss and Maurer must be credited with this particular combination.

This type of steel is subject to a very severe form of pitting corrosion which will result in enormous losses unless preventive measures are used. When such preventive measures are used the result is a fine piece of equipment which will give lasting satisfaction. But do not expect to attempt to use stainless steel in every part of the plant. It will not be satisfactory or economical and many other metals and alloys are to be preferred.

Since the solid metals and metal alloys are increasingly difficult to obtain, the next field for corrosion prevention should be examined, the field of protective

(Continued on page 120)

George Washington could have had a Jeep

All the raw materials needed to build a jeep were obtainable in George Washington's time.

Only the knowledge of how to obtain them, refine them and fabricate them into such a vehicle was lacking.

At Alcoa, we call this important ingredient "Imagineering". That's our handy word for letting imagination soar and then engineering it down to practical use. And this is the kind of a job that has a special appeal for young men interested in the future.

It's exciting and exhilarating work to let your imagination have free reign on the possibilities of light, strong aluminum—then engineer it down to earth. So there is plenty of opportunity in the aluminum industry for young men with imaginations that refuse to be limited by traditions.

There is almost no limit to imagineering with Alcoa Alloys in making things lighter, more attractive, more economical. All this adds up to making Alcoa Aluminum available in a greater number of ways, to a greater number of people at the lowest possible cost.

You can let your imagination soar on the future of Alcoa Aluminum and the part it will play in building a better world. It will be used in places and for things undreamed of now.

And we hope that many young men with vision will build their own future in the aluminum industry or in the many industries which will be using more aluminum than they have ever used before.

A PARENTHETICAL ASIDE: FROM THE AUTOBIOGRAPHY OF

ALCOA ALUMINUM

• This message is printed by Aluminum Company of America to help people to understand *what we do* and *what sort of men* make aluminum grow in usefulness.

CORROSION OF METALS

(*Continued from page 118*)

metallic coatings. Metallic coatings protect in one of two ways: by being anodic with respect to the base metal, such as galvanized iron where the iron is protected at the expense of the zinc; or by furnishing a complete, continuous coating on the surface of the base metal, in which cases there can be no pinholes present, for the base metal in this case is anodic to the coating and severe corrosion conditions are readily established.

Some types of metallic coatings available are: (1) clad metals, where the surface consists of ten to twenty per cent of the protective metal, and the two metals are bonded under special conditions to insure atomic contact; (2) dipped metals, where the protective metal alloys with the base metal and gives a continuous protective coating; (3) electroplated metal; (4) sprayed metals (often called metallizing), and others.

Great care is necessary in fabrication of clad metals to avoid cell action due to contact of dissimilar metals and the presence of welds. Available in the form of clad metal are stainless steel, monel, nickel, and inconel clad steels. The saving in strategic metals is great when it is considered that generally only ten to twenty per cent of the total weight consists of cladding. Likewise the saving in money should be appreciable unless the costs for fabrication are extremely high.

The use of silver is not new but is being proposed more and more, particularly under the influence of present economic conditions. It has been used to a limited extent in the chemical industry, likewise in the food industry in the preparation of jams, jellies and beverages. Silver lined pipe and containers should find wider use at the present time because of the resistance of silver to corrosion in general, and in particular to the very slight to negligible metallic contamination of food products along with the very satisfactory and easy methods for cleansing the silver surface. The resistance of the silver surface to alkalies or cleansing agents is greater than tin, and in addition the definite bacteriacidal action of the silver surface adds greatly to the arguments for the use of this metal at this time. The use of a small amount of silver in certain stainless steels did not improve the corrosion resistance of these alloys to salt water, but it did result in sheets with more attractive surfaces and better machinability.

The use of some of the gold that is being hoarded at Fort Knox might prove to be a good idea. Cladding and plating equipment would be the field for gold. It is certainly of little value in the ground, and properly used, with necessary care and protection, it could conceivably release a large quantity of strategic metal for defense purposes. From the corrosion point of view, it should represent almost the ideal metal, and the recovery of the scrap gold does not represent a difficult metallurgical job.

Another field of protective coatings is that of nonmetallics other than paint. This field appears to be very attractive at this time, in fact a field to be considered at all times. The use of glass or ceramic-coated iron is not new, but at present is being used in large quantities. An undesirable feature of this material has been that a break or fracture in such a surface is not always readily detected or easily repaired, thus accounting for the trend to the metal surfaces. But again present conditions are demanding a greater usage of glass-lined equipment with consequent improvement in quality and versatility of such coatings.

Rubber-coated equipment has a field which is limited at the present time, but where it can be used and is still available, the life of such equipment is extremely high. The resistance of rubber-coated steel to acidic conditions is fine.

The proper care of the existing iron and steel represents a large amount of work and calls for intelligent use of the methods available for this purpose. The first step in the care of new or corroded iron or steel is to clean the surface well. Methods used for cleaning the surface of iron and steel are flame cleaning, sand or shot blasting, scraping, wire brushing, descaling, pickling and others. The merits of the different methods will not be discussed here, but let it be emphasized that any method chosen must clean off all rust, scale, dirt, grease, or other foreign matter on the surface. This is the first and most important step if good adhesion of the paint film is to result. For some types of work there is available a method of surface conversion or chemical dip coatings. These methods call for the use of phosphates and chromates to bring about an inhibiting condition on the surface of the metal along with excellent adhesion of paint films. Onto either the cleaned metal surface or the chemical-dipped surface must be applied a priming coat. The priming coat of paint should be of the inhibiting type which serves to create and maintain at the interface of the paint and steel, a condition which will minimize corrosion. This is accomplished by using a pigment which is known to possess inhibiting properties, such as basic lead chromates, zinc chromate, zinc oxide, zinc dust, or red lead.

At present it appears that it is still desirable to have a paint pigment present which has a definite but low solubility in water, and at the same time possesses inhibiting properties, such as zinc chromate. The purpose of this type of pigment is to allow a small amount of the pigment to dissolve in water, when small cracks develop in the paint film, thus carrying to the surface of the metal some water containing an inhibitor. This type of pigment has shown excellent promise in service tests.

After the application of proper base or priming coats, successive coats become less important. But there is one point to be mentioned here — the choice of a proper vehicle to carry these pigments. The use of linseed oil vehicles has been advocated and used to good advantage for years, but some of the newer type synthetic resins may prove to be better. Whether of the phenolic-formaldehyde type or the alkyd resin type, they are to be considered in future paint practice and may replace linseed oil to a great extent.

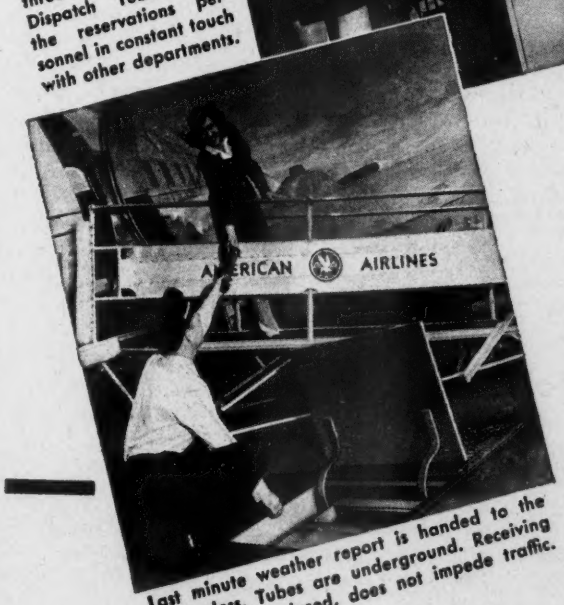
The prevention of corrosion by means of passivation assumes a very important role when dealing with boiler and steam production problems. The passivation is secured by the use of inhibitors which bring about a surface condition on the metal which retards or prevents corrosion. The use of chromates in brine solution is one of the well known examples where corrosion may be reduced to a minimum by use of inhibitors. Likewise silicates and phosphates are used to alkalize water, reducing corrosion to a considerable extent, especially when applied under proper conditions.

In conclusion let it be emphasized that there never has been in the past, nor does there exist today, and there will never be in the future an ideal corrosion-resisting metal or alloy except for one set of conditions. Just as there is no specific drug to cure all the ailments of the human body, and no one expects to find one, so it is with those who deal in corrosion problems, for it is realized that the best solution often represents a compromise of many factors.

Air Speed ON THE GROUND...

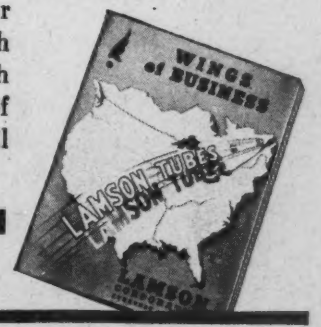
Three incoming and three outgoing Lamson Dispatch Tubes keep the reservations personnel in constant touch with other departments.

Human messengers are much too slow for the streamlined efficiency of American Airlines. At the Washington airport, Lamson Dispatch Tubes interconnect the reservation and ticket offices, on the second floor of the Terminal Building, with the load room downstairs, and the loading ramp a quarter of a mile away. Weather reports, manifests, memoranda, unerringly speed to the proper destination. Confusion and delay have been entirely eliminated in the handling of paper work.



Last minute weather report is handed to the stewardess. Tubes are underground. Receiving station, when closed, does not impede traffic.

Ten times faster than human messengers Lamson Dispatch Tubes never make a mistake, never take time out for lunch. Write for our booklet, "Wings of Business" which shows the speed and efficiency which Tubes can bring to the handling of paper work, small objects and small tools.



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In locker plants everywhere — including the world's largest, at Oklahoma City, here shown— provides the steady low temperatures that mean the safe storage of food. You can profit by our 62 years' experience in food storage work; find out now what Frick Refrigeration, Frick Freezers, and Frick-Knickerbocker Lockers can do for you. Bulletin 145 gives the whole story on just how satisfactory and dependable they are. Write your nearest Frick Office or Distributor.
FRICK COMPANY
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THE BULLETIN BOARD

(*Continued from page 116*)

One of the speakers will be Dr. K. B. McEachron, research engineer in high voltage practice for General Electric, who will give an illustrated lecture on his studies of lightning atop the Empire State Building. The talk promises to be both entertaining and instructive.

Professor Hazen, head of the Department of Electrical Engineering and Power Practice, will speak also on the postwar plans of M. I. T. some time next January. In view of the recently published developments in this field, the talk should be of great interest to all. Another possibility is a lecture on television by engineers of the Philco Corporation, including an actual transmission from a local Boston station.

Code classes will be continued by the Branch. Anyone interested is invited to attend. There will be instruction for both beginners and advanced students.

At a business meeting on November 21 committees were appointed and plans for field trips and other speakers were discussed. The Branch now numbers one hundred and fifty on its rolls.

INVISIBLE SEARCHLIGHT BEAMS

Ultraviolet screens of dark purple glass are used by the Signal Corps to transform searchlight beams into invisible light. Used in connection with cloud height finding devices, these screens filter out all visible light from the tiny but powerful match-shaped mercury lamp, which operates at so high a temperature that it must be constantly aircooled. The screen sometimes reaches temperatures far exceeding that of boiling water, and is therefore built in small panes to localize shock caused by exterior temperature changes.

The complete cloud height determining system consists of a ceilometer, light projector and special recorder. The invisible beam is shot up to the cloud base by the projector. The ceilometer, actually a photoelectric scanning device, indicates the location of energy reflected from the cloud base. The ceiling height is then computed by triangulation.

TELEVISION

Coaxial cable is now being used regularly for commercial television transmission over short distances, and has also been used experimentally for long-distance television in preparation for large-scale postwar use. It appears to be the only continuous physical structure now available which can carry over long distances the several thousand kilocycles' band width required for television transmission. Conventional telephone cable pairs have been adapted for television over distances of a few miles, but conventional long-distance telephone cables car carry a band width of only about 50 kilocycles, far short of television's requirements.

Another possible alternative to coaxial cable in television is use of directed ultra high-frequency radio beams relayed periodically by means of radio relay stations located on hilltops or other high structures so that no other intervening hills or structures will intercept the radio beams. If such a system should prove successful and capable of operation at reasonable cost, there is a possibility that radio relays will be used extensively in long-distance intercity communications for both telephone and television transmission.

The practicability of coaxial cable in long-distance television transmission has been successfully demonstrated on existing installations, particularly the Minneapolis-Stevens Point cable whose four coaxial units were looped together to form about an 800 mile circuit. With the New York-Philadelphia coaxial cable a band nearly 3,000 kilocycles wide can be made available for television transmission. Future developments now in prospect are expected to permit the transmission of a considerably wider band of frequencies over a single coaxial unit.

Industrial Bulletin of Arthur D. Little, Inc.

Russian has now become the third language of chemistry, following English and German and displacing French. English remains the language of over 40 per cent of chemical publications and German of some 15 per cent; but French, which is taught in most technical schools along with scientific German, has been used in only five per cent of such papers since 1940, compared with 13 to 15 per cent for Russian. Liberation is expected to increase the volume of French chemical publication, but overtaking of the Soviet Union's growing lead appears doubtful.

Industrial Bulletin of Arthur D. Little, Inc.

"Achievements in the Field"

320,000
BARRELS PER HOUR

PACIFIC'S ANSWER TO A GREAT PUMPING PROBLEM

CIRCULATING hydrocarbon fluids at the rate of 320,000 barrels per hour, day in and day out—accurately meeting, with efficiency and economy, the countless variations in flow conditions encountered in the manufacture of essential aviation gasoline, synthetic rubber and other allied products . . . this is the function of Pacific Engineered Centrifugal Pumps installed in the new, modern Cities Service Refinery, recently completed and now in operation at Lake Charles, Louisiana.

Pacific was chosen because of its unsurpassed range of types and sizes, developed and imbricated to insure the highest pumping efficiency, widest operating economy and greatest margin of safety. Correct design and construction provide incredible endurance even under the most severe conditions. Performance records prove this!

PACIFIC PUMPS, INC.
Huntington Park, Calif.

PACIFIC PUMPS, INC.
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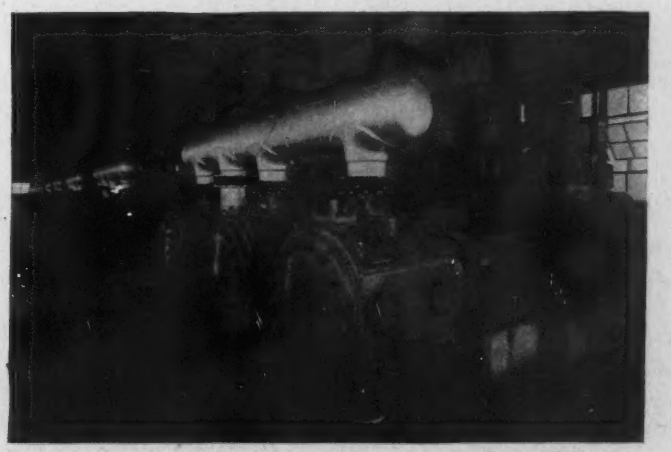
Clark 800 BHP "Angles"

Five 8-Cylinder 800 BHP Clark Super 2-Cycle Angle Compressors are in service in the combination gasoline plant and gas booster station of the El Paso Natural Gas Company at Jal, New Mexico.

In less than five years, nearly 50,000 BHP of Clark "Angles" have been installed by natural gas companies as gas driven natural gas compressors.

"Two of the Dresser Industries"



Clark Compressors in El Paso Natural Gas Company Plant, Jal, N. Mex.

CLARK BROS. CO., INC. • OLEAN, N. Y.

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For years, drilling experts have recommended these Harrisburg Products for reasons that describe each of them:

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Harrisburg Pump Liners—special seamless steel; milled, ground and polished to gun-barrel smoothness; accurate dimensions; the choice of drilling experts.

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Engineering Draftsmen Needed for Federal Service

The Civil Service Commission has announced a continuing need for engineering draftsmen to work on the construction of maps, strategic posters and graphs, and technical plans in various Government agencies in Washington, D. C., and in other parts of the country. Women are particularly urged to apply. There are approximately 300 vacancies in Washington alone, existing largely in the Coast and Geodetic Survey of the Department of Commerce, in the Geological Survey of the Department of the Interior, and in various Bureaus in the War and Navy Departments. Positions for men only are open in Pearl Harbor.

Salaries range from $1,752 to $3,163 a year, including the amount for required overtime. For the $1,752 grade, applicants must have completed a drafting course in high school, college, or drafting school, or have completed a war training course in drafting, or have had three months of practical experience. Training or experience in commercial art, interior designing, or similar fields is considered qualifying. For the higher grade positions, the experience or training must be progressively more difficult and responsible. There will be no written test and there are no age limits.

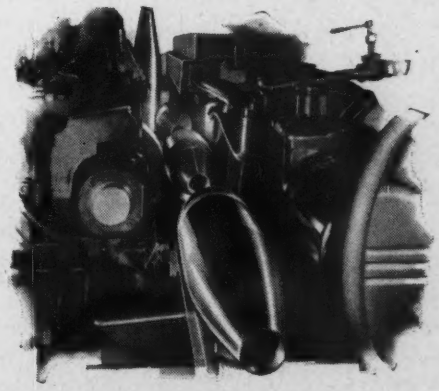
Applications will be accepted in the Civil Service Commission until the needs of the service have been met. Each applicant must submit with his application a sample of his drawing and lettering. The proper form for applying may be secured at first- and second-class post offices, from the Commission's regional offices, or direct from the central office of the Civil Service Commission in Washington 25, D. C.

Appointments to Federal positions are made in accordance with War Manpower Commission policies and employment stabilization programs.

The shell that brings 'em back alive-

What makes a Nazi surrender? Sometimes it's a "prisoner passport" delivered in a propaganda shell, compliments of the U. S. Artillery. Today industry is turning out all types of shells faster than anybody ever dreamed. Certainly Carborundum takes great satisfaction from the big part its products play in this vital war job! Nowadays shells big and little pour out of centerless grinding machines like this in a never ending stream.

Abrasives by Carborundum also keep tools sharp, and finish metal, wood and plastics. Super Refractories by Carborundum line high temperature furnaces and help solve the problems of the process and chemical industries. "Globar" electric heating elements increase the efficiency of high temperature heat treating furnaces, ceramic kilns, etc. This wide industrial coverage offers exceptional opportunities for Engineer-salesmen. If interested, please write The Carborundum Company, Niagara Falls, New York.



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HELP YOU MAKE THINGS BETTER
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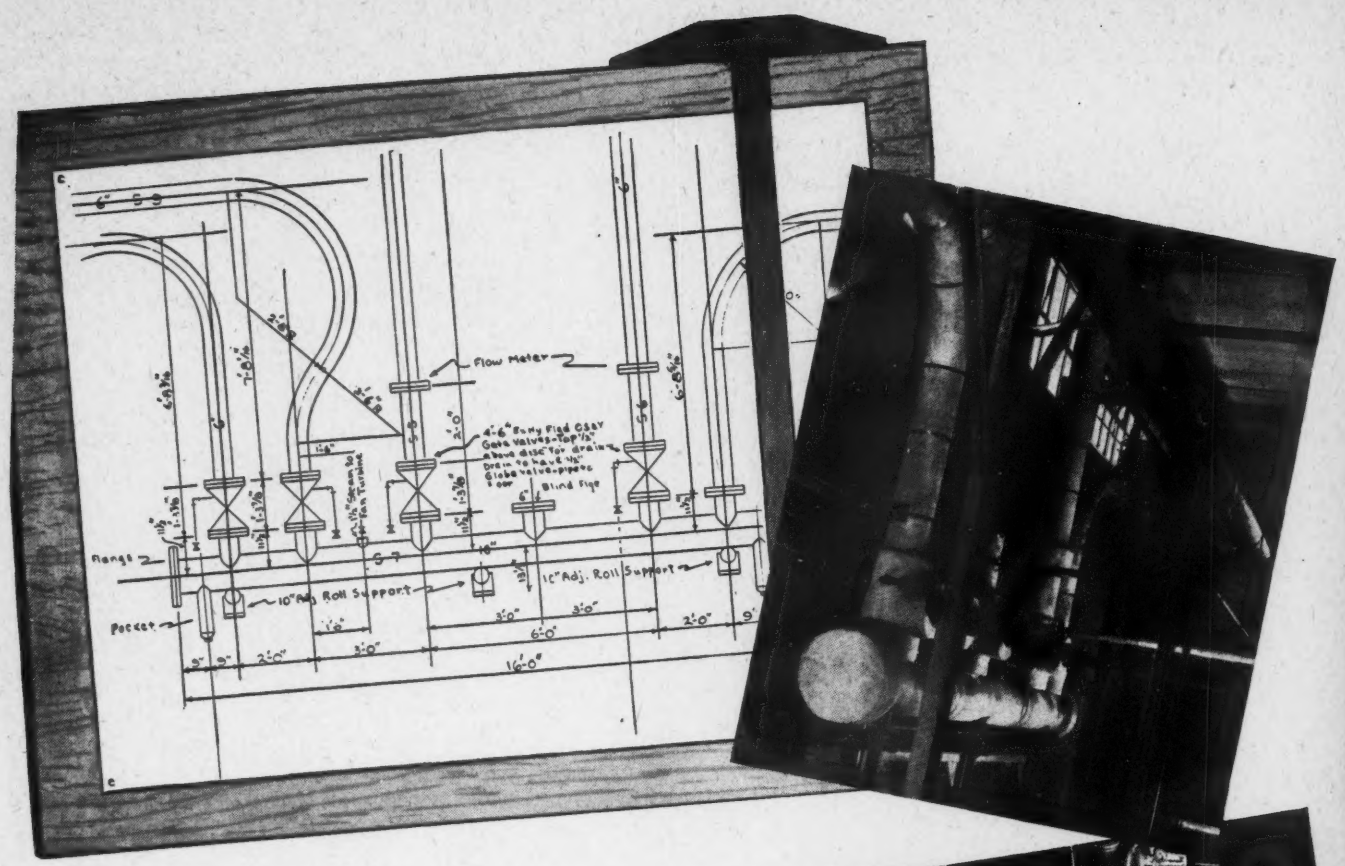


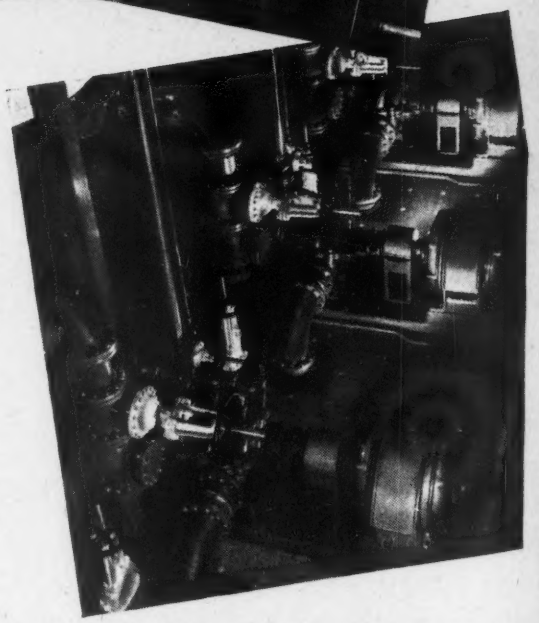
You can't take piping *for granted*

WHEN you draw a piping line on a blueprint—when you indicate a symbol that means a valve—remember that ultimately those lines and symbols will have to be translated into hard metal, and that those lines you draw will have much to do with determining the success or the failure of the engineering project.

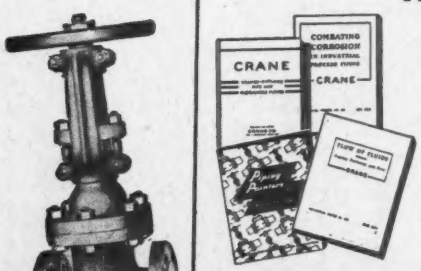
The parts that make up any piping system are many. But each one of these parts—the pipe, valves and fittings; the traps, joints and gauges; the flanges, unions, gaskets and insulation—is part of the complete Crane line.

When you are writing specifications, keep this fact in mind: Crane's single source of supply, Crane's experience, and Crane's reputation for high quality will do much toward assuring the success of the systems you design.

CRANE CO., General Offices, 836 S. Michigan Ave., Chicago 5, Ill.



HERE'S ENGINEERING DATA TO HELP YOU



Crane engineers have prepared a number of important books and treatises on piping equipment and piping systems. These include the Crane Catalog, *listing more than 48,000 different piping items and containing valuable engineering data*—Piping Pointers Manual, *packed with information on piping installation and maintenance*—Flow of Fluids *and* Combating Corrosion, *two technical papers of value to anyone laying out pipe lines.*

On file for reference in Engineering Library

CRANE

VALVES • FITTINGS • PIPE
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BRANCHES AND WHOLESALERS SERVING ALL INDUSTRIAL AREAS

Life FROM A PLASTIC BAG!

THE MAN ADRIFT here is drinking sea water. But it is sea water that he has made drinkable by chemicals and a filter contained in a VINYLITE plastic bag*. The plastic—produced by CARBIDE AND CARBON CHEMICALS CORPORATION—has been made possible by the availability of synthetic organic chemicals, in which this Unit of UCC specializes.

But the story behind VINYLITE plastics is far more than just the history of another chemical development.

Rather, this unusual substance is indicative of the way man can learn—through years of uninterrupted research in the basic and applied sciences—to make better material than nature. It is one more confirmation of the continuing progress that is achieved by co-ordinating research, development and engineering.

The importance of VINYLITE plastic in helping to solve such vital needs as fresh water at sea is typical, in terms of human progress, of the stature already attained by many of the 160 synthetic organic chemicals that CARBIDE AND CARBON CHEMICALS CORPORATION now has in commercial production.

▼

**There are good reasons why a VINYLITE plastic is used in desalting bags. It can't mildew or rust. It is strong and tough, scuff-proof and shock-proof. It is chemical-resistant and sun-resistant. It is lightweight, transparent and flexible. It is non-flammable and cleanable . . . Engineers and executives interested in this material are invited to write for the booklet P-12 "Vinylite Plastic Sheet and Sheeting."*

BUY UNITED STATES WAR BONDS AND STAMPS

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30 East 42nd Street UCC New York 17, N. Y.

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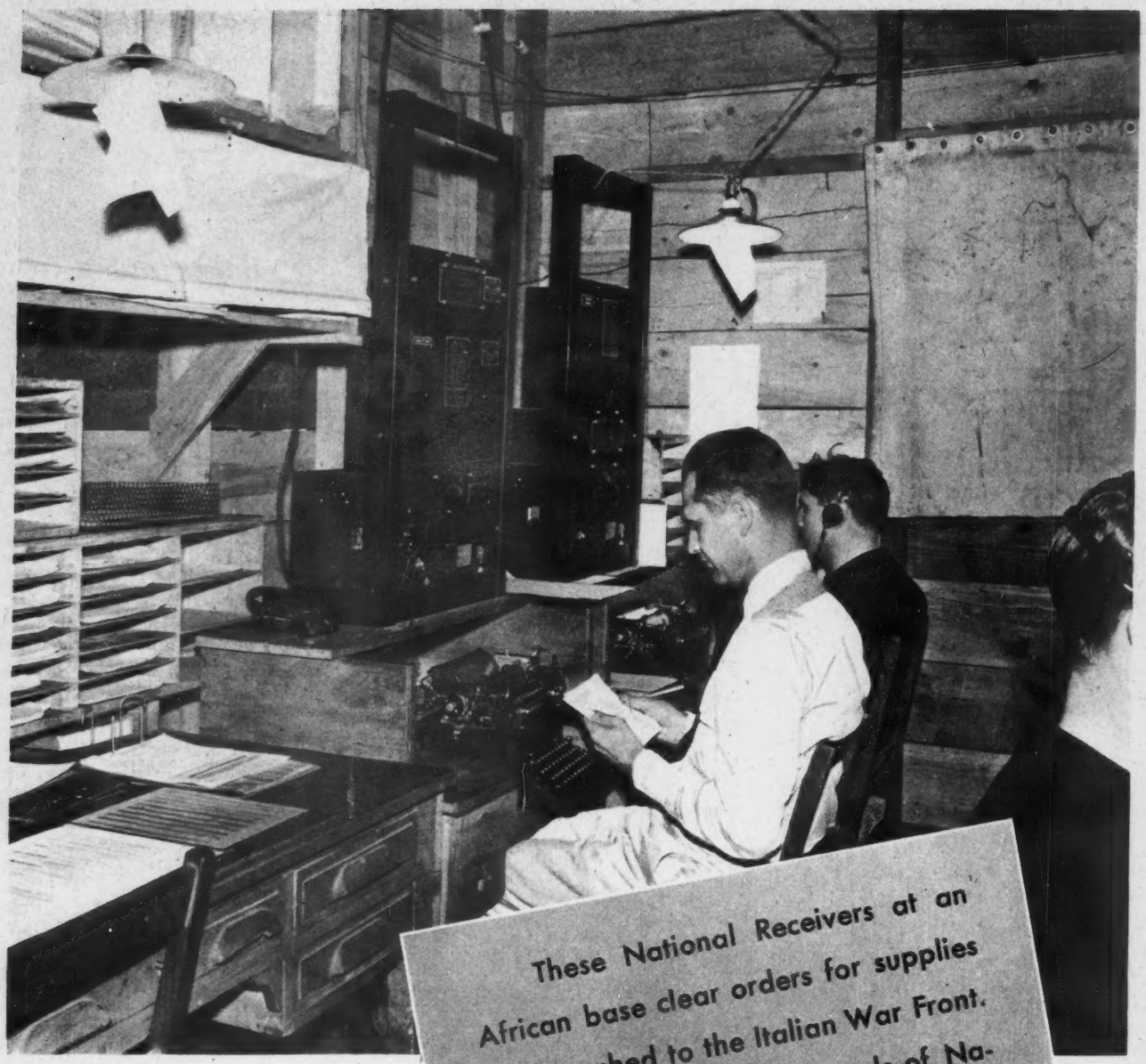
INDUSTRIAL GASES AND CARBIDE—The Linde Air Products Company, The Oxweld Railroad Service Company, The Prest-O-Lite Company, Inc.
PLASTICS—Bakelite Corporation



These National Receivers at an African base clear orders for supplies being rushed to the Italian War Front. They are typical of thousands of National Receivers in key spots throughout the world, serving the Armed Forces with superb dependability and performance.

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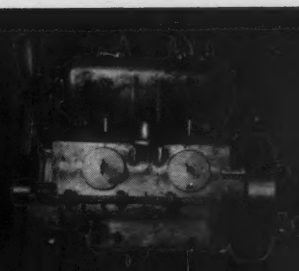


First Engine with Cylinders Cast en Bloc

Famous "Firsts"

by NEW DEPARTURE

The name New Departure aptly describes an organization whose thought and action has ever been in advance of its time.

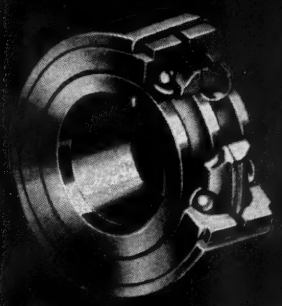
A partial record of the "new departures" by New Departure is reported on this page.

Well over 200 million New Departure ball bearings are in this war, and we will stay with this task until the job is done.

But your postwar plans for anti-friction bearings might well take advantage of New Departure's creative engineering.

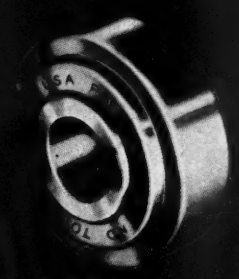
New Departure, Division of General Motors, Bristol, Connecticut. Detroit, Chicago and Los Angeles.

CORNELL UNIVERSITY ITHACA, NEW YORK

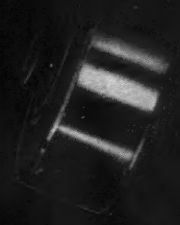


First Dual-Purpose Ball Bearing

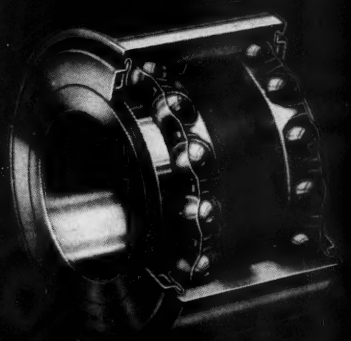
First Conveyor Roll Bearing



First Self-Sealed Lubricated-for-Life



First Successful Treadle Roll Bearing for Textile Looms



First Self-Sealed Lubricated-for-Life Mine Car Bearing

First Pump Shaft Bearing Self-Sealed and Lubricated-for-Life

Rockwell Hardness Tester

FEB L 1945

GE Campus News

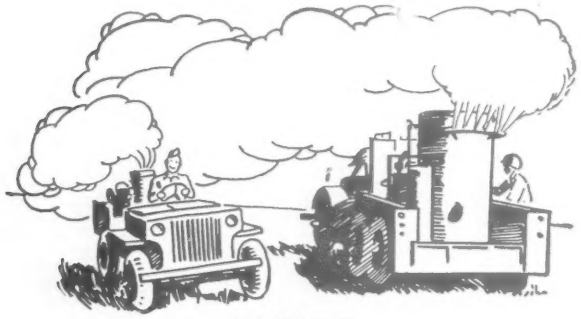
RESEARCH AND ENGINEERING KEEP GENERAL ELECTRIC YEARS AHEAD

CHRISTMAS DINNER IN THE TROPICS

IT is more than likely that many of the American boys in the South Pacific will have turkey for dinner this Christmas. It's not a military necessity, but it's good for morale, and high morale is an asset for any fighting force.

Good refrigeration equipment—the same sort that cools blood plasma, medical supplies, drinking water, and stores of ammunition—will make this possible.

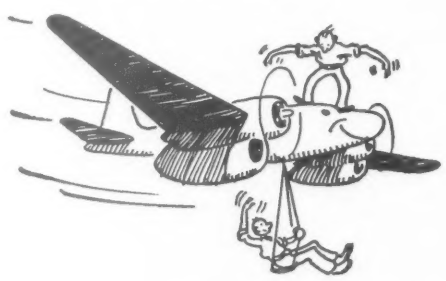
Recently, in collaboration with U.S. maritime and naval architects, General Electric engineers designed new, prefabricated refrigeration equipment for Victory ships which saves cargo space and materially reduces shipyard installation time. These refrigeration systems furnish 3½ tons of refrigeration for low temperature meat and fish rooms, and 3 tons of refrigeration at 40° F for vegetable, dairy, and thaw rooms. And six and a half tons is a lot of Christmas dinner in anybody's language.



JUNIOR

A LARGE smoke generator, principles for which were worked out by Dr. Irving Langmuir and Vincent Schaefer of the G-E Research Laboratory, produces a heavy blanket of smoke which has been used frequently to protect our men during landing operations. Now the Chemical Warfare Service has designed a smaller model.

"Junior" will fit into a jeep or a foxhole; can be carried by two men. With favorable wind conditions, it can blot out an area five miles long and 200 yards wide. The smoke will help the doughboys when the going is tough on jungle trails, mountain passes, and other vulnerable places.



NO STREAMLINING HERE

MOST airplanes look smooth. But some are definitely "lumpy." The plane which General Electric calls its flying workshop is of the lumpy variety.

It cruises high over Brownsville, Texas, carrying engineers and new equipment. Many new aircraft products and systems built in the laboratories and experimental shops of General Electric receive their first trial by air in this strangely shaped plane. It's one way G.E. makes certain that its aircraft equipment can stand the rigors of high altitude flying. *General Electric Company, Schenectady, New York.*

Hear the General Electric radio programs: "The G-E All-girl Orchestra" Sunday 10 p.m. EWT, NBC—"The World Today" news, every weekday 6:45 p.m. EWT, CBS.

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GENERAL ELECTRIC

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